DUSTY DAWN

DUST AT WORKPLACE & WORKERS' NIGHTMARES

Edited by
Harsh Jaitli and Ashesh Kumar

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HARSH JAITLI
DR ASHESH KUMAR

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Preface

Dust related respiratory disorder is one of the major causes of disability and death among the Indian workers. Irrespective of the sector and nature of the work this disease cuts across all of them. The situation is further aggravated by wrong diagnosis and treatment. According to one study, 11% of the total workforce involved in the coal mines in Bihar have the symptoms of pneumoconiosis, whereas the cases identified are negligible. That is the reason why we have more patients of "tuberculosis" in the industrial towns. Most of the workers who are under treatment of tuberculosis do not recover even after taking medicines for many years. The weakness of our reporting system is reflected in the poor figures in government statistics. Due to faulty identification mechanism no step is taken for prevention. Workers are forced to wear masks rather than initiating any step to control the dust at the source. Face masks are definitely cheaper than the electrostatic precipitators. Most of the time they are not suitable which makes their use more harmful. By this action the management shifts all the responsibility on the workers.

For more than one decade PRIA has been active in conducting research, studies, training programmes and producing educational material in the field of occupational and environmental health. It has been our experience that any steps taken in this direction are always welcomed, because there are only a few initiatives. In August 1994, Envirotech Instruments Pvt. Limited, the producers of indigenous pollution monitoring equipments, organised the national scientific research papers contest on the issue of dust related lungs diseases. More than 85 papers were received and out of them some were selected by a committee of experts. In this document we are printing those selected papers with the hope that they will motivate other researchers in the field to undertake similar studies in future.

I would like to thank the Envirotech Industries for organising this competition. I am also thankful to the team of Centre for Occupational and Environmental Health for compiling this book.

Dr. Rajesh Tandon
Executive Director
PRIA

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Introduction

Man and nature have always been antithetical. Man is the only animal on earth who continuously tries to conquer nature. In all his inventions he has tampered with it in order to satisfy his needs. During the agricultural revolution it was man, land and crops. In the industrial era it became, man, machine and environment. But the most dangerous is the present relationship in which he has started tampering with the biological composition of species, through genetic engineering.

From the very first day when man stepped out of his state of nature, he started not only tampering with nature but also exploiting his fellow beings to generate profit. The control of land and then ownership of the means of production by a few led to the development of a separate class known as labourers. Although they were the main component in transforming natural resources into consumer goods, they have been neglected since centuries.

Today, throughout the world, thousands of workers die or are maimed every year in various industrial accidents at the shopfloor. In India, if only reported accidents are taken into consideration, the figures are much higher than those of the developed countries. Dickensian working conditions prevail in our country still. India is known for its diversity not only of culture, religion or language but also of living and working conditions and the nature of industries present. In public sector undertakings the regular workers live in good houses and are paid handsomely but on the other hand contract workers live in ghettos, are meagerly paid and lack basic medical facilities. But they share one thing in common - the prevalence of occupational hazards, which vary in degree depending on the nature of industry and the workforce. Information on health hazards is not disclosed to them. This is always closely guarded and highly manipulated in both public sector and private sector.

The menace of occupational diseases is very rampant in the country, with thousands of workers dying every year of pneumoconiosis, asbestosis, silicosis and heart or liver ailments. This problem is not only confined to industries or mines but also to the workers in offices, agricultural and domestic work. Any wrongly planned activity can cause health problems in the long term. Its manifestation may take time but no one can deny it with impunity.

In factories the recorded number of dead workers was as high as 806 in 1980. This figure does not include mines, railways, transport, construction, agriculture and small scale industries, which do not come under the purview of the Factories Act. It is estimated that during the harvesting season every year, around one thousand workers become victims of thresher related injuries.

On one hand we see the tremendous increase in the number of deaths and injuries due to accidents in the industries, on the other hand occupational diseases are also creating a serious situation. Accidental injuries being more visible, not only attract immediate attention of the community but also get compensation with ease. Occupational diseases are not so visible as their symptoms take time to manifest. Many workers have lost their hearing capacity due to the high noise level at the workplace. Serious threat to workers health is also posed by exposure to excessive heat, vibration, chemicals, acids, etc. Chemicals such as mercury and lead compounds have many deleterious effects on the nervous system of the workers exposed to it. Pesticides play havoc in their production process as well as their use in agriculture. Women workers in informal as well as in formal sector are victims of various occupational diseases like hormonal disturbances, gynaecological problems, back-ache etc. Many chemicals and radio-active materials cause cancer and affect the reproductive capacity of men as well as women.

The problem of occupational health and safety is monstrous and the price paid by the workers, tremendous. The government, legislators, courts and doctors have not proved to be of much help. Part one of this paper deals with various problems which are faced in occupational health in particular and environmental health in general. In the second part I have tried to put forward some solutions which can be brought about if we want to achieve targets like health for all by the end of this century.

Part–I

Myths

Vinegar is diluted acetic acid. It is edible, adding taste to the food with which it is served. Acetic acid in vapour form however causes diseases. It can cause burns, dermatitis, conjunctivitis or ulcers. Inhalation of acetic acid causes irritation of mucous membranes.

The safe limit value of acetic acid is 10 parts in 1 million parts of air. Oxygen normally is 2 lakh parts in one million parts of air.

A manager argues "acetic acid is harmless, as it is edible", however in reality it results in a number of diseases.

Cotton dust also causes a lung disease known as byssinosis. This fact is accepted by law in India now. The disease however is very often incorrectly diagnosed as TB.

The myth of immunity "After some time many workers develop immunity to dusts and chemicals". "Only visitors and weak people cannot stand dust, whereas workers can work for 8 hours (even longer) per day for many years because they are not fragile". "Only the weak are affected by dust. The fittest always survive".

"Alcohol, jaggery, milk and toddy can cure the respiratory disorder caused by any dust or chemical."

These are some of the most common myths we encounter in the field.

Everybody is not affected at the same time and during similar years of service, thus giving rise to an illusion of the immunity in unaffected workers. The prevalence of any occupational or environmental disease largely depends upon the period of the exposure and the volume of the pollutant. Another reason for the prevalence of the myth is that the symptoms of the diseases sometime take a long duration to manifest.

Health and safety as a national priority?

In any production process there are three things; raw material, machines and labour. The cost of the former two depends on the market. Industry has no control over the cost of machines, raw materials or electricity. Industries exist only because they have to maximise profit and keep the production cost at the minimum. So the only input where they can control the cost is labour, which is abundant in India. Industrial revolution in the true sense started only during the British rule. Being a colonial ruler the objective of the state was to extract maximum profit, while labour and natural resources subsidised the cost. After independence the slogan was to become self reliant, which was possible only if the thrust was on maximum production at minimum cost. Labour remained the last priority. Now during the days of liberalisation, lots of new technologies are coming in and the thrust is on how much foreign currency we can earn. The advertisements which appear in the newspapers on collaborations, always talk of their economic viability. In a nutshell one can say that we have always neglected the aspect of safety and health, whether of workers or of the community.

Occupational Health and technology transfer due to new economic scenario

India is moving very fast on the path of liberalisation and also becoming the garbage dump of the technologies of the west. Expenditure on health and social security is decreasing due to liberalisation.

Also, the number of unorganised and contract workers are increasing due to policies of retrenchment and voluntary retirement schemes. Companies are also seeking more freedom in the hiring and firing of employees. It is generally observed that the permanent workers are aware of the hazards involved in their work; if they are organised then many a times they also refuse to perform it. So companies employ contract workers to do the same work. Since these workers are not organised they cannot protest or demand safety precautions. No information or training can be provided because their employer and place of work is not fixed. This also hampers their right to get compensation if they are disabled.

We produce certain goods in spite of world wide ban on them. We also produce and consume the deadliest pesticides and insecticides (also known as the dirty dozen). Asbestos is banned in most of the countries as it has now been scientifically proved that there are no safe limits of asbestos, but in last one decade this industry has flourished in our country. Only 20% of raw asbestos is mined in India, while the rest, which is around 100,000 tons is imported mainly from Canada, Brazil, Zimbabwe, Russia and Kazakhstan. The next industry in the race is foundry. Foundry is declared as one of the most hazardous industries in the developed world, but it is also a fact that it is the backbone of the engineering industry. Now India along with other developing countries has been identified as the country where it can be processed and exported to developed countries. If all the safety laws abide in the US, the cost of production goes up, whereas in India skilled labour is cheap and laws are also relaxed. So it is economically beneficial to produce these hazardous materials here and use them in the west. The import of the hazardous waste like lead batteries and plastic waste has also increased.

It takes one whole generation of workers to know the negative effect of any technology. A proper cycle works in technology transfer. Technologies are invented in the west; when it is felt they are hazardous, they are transferred to less developed countries. Even in these less industrialised countries they are first installed at industrially advanced states (Gujarat, Maharashtra or Karnataka and then transferred to industrially backward states, Orissa, M.P.). So at every stage, one generation of workforce is sacrificed if a proper check is not kept on such transfers. Since liberalisation a free flow of such technology is being promoted; there is an urgent need to be more vigilant about such technology transfer.

Occupational health and medical sciences

The knowledge and practice of occupational health has always been the least priority in the overall agenda of medical sciences. From the primitive stage to the modern hi-tech age, workers have always played a very significant role as partners of economic and social development. They have however, never got their due right to a safe and healthy life.

Rosen in his book "The History of Miners' Diseases" mentions the detailed account given by Diodorus Siculus, a greek historian, who visited Egypt in 50 B.C., about the Nubian gold mines under the Ptolemies. Hippocratic medicine was limited in its application to a section of people. A treatise like 'Air, Water, Places' was written for citizen doctors with citizen patients in view, and those too of the leisured class. Hippocrates was not alone in his neglect of workers; the possibility that occupational factors could be of importance in diagnosing a given illness was ignored all through the dark ages. More than 2000 years elapsed before the revival of learning brought this idea to the notice of men. Throughout the medieval period there was no contribution to the subject of occupational medicine and it was not until the 16th century that we find definite information relating to the diseases of miners and the workers involved in hazardous trades. It was in the middle of the 16th century that Agricola and Paracelsus wrote on the subject followed by the classical work of Ramazzini. Georgius Agricola in his work 'De Re Metallica' deals with every aspect of mining and with the smelting and refining of gold and silver. The English translation of his work was done by Herbert Hoover (who later on became the president of U.S.A.) and his wife. In his work he mentioned how common accidents in the mines were. Miners slipped from the ladder into the shaft and broke their limbs or their necks or they fell into the slump at the bottom of the shaft where they drowned. He writes about the accident in Remmelsburg near Golsar in which 400 workers lost their lives. In 1567, eleven years after the publication of Agricola's work, the first monograph devoted to the miners and the workers involved in smelting works appeared. The author of this work was Aureolus Theophrastus Bombastus Von Hohenheim, normally known as Paracelsus. But the most significant work in the field of occupational medicine was done by Ramazzini, the father of occupational medicine. In his 'De Morbis Artificum Diatriba' he makes a striking contribution to the art of diagnosis.

The common public and workers were not considered in the development of medical science, until their diseases started affecting the elite. Since the Roman days, the state and its beholders realised the importance of health for maintaining peace in the state. Disease due to natural or man caused epidemics could destabilise the life of the community or a country, which in turn could affect the state. This was the reason for the concept of social medicine coming into existence. This fact has been neglected by the propagators of the liberalisation policy in India. The contribution to government hospitals has decreased while private hospitals are

promoted. Plague eruption has exposed this policy in front of the national and international community. On one side we have government hospitals starving for basic funds, machinery and trained manpower, and on the other hand private and commercialized nursing homes are flourishing. They provide expensive medical care and absolve themselves from social responsibility. During the outbreak of plague not only did small nursing homes close their doors but big private hospitals also refused to admit patients. This situation reiterated the need to rethink about our national health policy.

Lack of knowledge of the doctors

Lack of information also affects the doctors and para medical staff. In the general graduation course of medicine there is very little input on occupational and environmental health. The pace at which new chemicals are introduced is not compatible with the research done. General doctors are also unaware about the notifiable diseases mentioned in the Factory or Mines Act. (Once when doctors practicing in an industrial area were asked about notifiable diseases, they suggested the names of TB, measles, etc.) According to the Factory Act a doctor finding a case of occupational disease should immediately notify it to office of Factory Inspector or Mines Inspector, so that steps can be taken for its prevention. Equipment like lung function test machines is available in many big hospitals only. ESI hospitals which are meant for catering to the needs of workers on the other hand lack qualified doctors, equipment and medicines. These hospitals are now involved only in issuing medical certificates for paid medical leave, most of which is done by extorting ten rupees from the worker. Majority of workers do not go for medical treatment to these hospitals even if a contribution is deducted from their wages.

Role of science and its beholders

It is generally believed that scientists are most rational and neutral people, but there are numerous examples which present a totally contrary picture, in the context of occupational health. In the area of workers' health it is observed that in the case of any accident due to environmental reasons (i.e. faulty valves, missing guards, unprotected moving parts of machines) the responsibility is dumped on the workers behavior. When these incidents occur expert opinion is taken. Experts hired by factory owners are briefed about the problem from the owners perspective, which is naturally based on the theory of careless behavior of the workers. This input definitely influences the so called scientific exercise. Workers are asked to wear helmets, boots, gloves, masks or other PPE's. Normally the scientific method to solve any problem is to identify its root cause and then take some action. Suppose there is a dead rat in your room, what you will do? Remove the dead rat or cover your nose and live? But

the method followed in solving OHS problems is covering the nose and not removing the dead rat. No effort is taken to check the pollution at the source; rather a short cut is followed which increases the worker's vulnerability.

Such an unscientific approach is propagated through pamphlets, educational materials, discussions or seminars. Breathing is identified as the root cause of the disease rather than the dust. May be one day we can develop a system by which breathing can be stopped, because our target is not removal of dust but containing the worker. Even the hoardings about road pollution say "wear a mask to save your lungs", contrary to the rational statement like "keep vehicles in good condition so that no smoke is emitted". It is an individualistic way of problem solving which says "save your lung and generate smoke for others on the road".

Management's perspective of OH

We believe that profit maximisation is the only reason for the existence of any industrial activity, but we forget the fact that no industry or commercial activity has the right to exist if it cannot satisfy the basic needs of its employees. The major concern of management of today's world of cut throat competition is, how to generate profit from its activity and also build its reputation in the market. If we look at the problem in a traditional way then human resources is the only thing which is in abundance in India. If you want to maximise your profit (for which industry exists) you can only reduce the production cost by reducing the expenditure on labour. If one is disabled there are thousands outside the gates of industry waiting for employment. Rules and regulations also are not very strictly enforced. Each factory inspector has more ten thousand factories to inspect in one year. Management is done in a closed fashion rather than an open one. The target of the Indian employer is to provide facilities which are the minimum required by the law. That is not his fault because no study has ever been taken up in India which can prove that better working conditions improve productivity. Some industries have improved their profitability by waste recycle and providing better working conditions but it has not been documented. Situations are also changing due to the nature of the skilled labour involved. Unsafe work culture in industries exists only because it is not checked by the shopfloor supervisors.

Role of workers and their associations

But nowadays the situation has totally changed. Workers participation is solicited in every field, not as a legal requirement but for safe work practices. We have documented the case studies where the workers have participated and improved the workplace situation without much extra cost. But even today, safety committees which are compulsory in some industries, are reduced to token participation. Certain hurdles are generated which stop the

free flow of information. For example these meetings are held in English; workers don't know this language; members belonging to one department are not allowed to visit another department, members are nominated rather then those with genuine interest elected. At some places it has been observed that safety committees are projected as rivals or alternatives to the union. This creates disharmony among workers. In the last part of this paper some methods are suggested to make these committees an effective tool for better management of workplace environment rather than a white washing exercise.

One reason for lack of attention on the part of unions to this issue is the unemployment crisis in the society. Most of the struggles of Indian trade union movement still revolve around securing employment. This problem is further aggravated by the anti-labour policies of liberal economy. Now a days even organising is difficult in the informal sector. In big cities like Bombay, Delhi or Calcutta, retaining jobs has become a major concern even in big industries. "Even in this situation many workers are active at the shopfloor level about their health as it becomes a question of life or death", said a worker in a chemical factory. But why is it such workers do not get much support from their union?

If at all we have to live in a society fit for human beings, unions and the community have to enter the area of production methods more actively. They have to decide not only how to produce but also 'what to produce'. The developed countries are pushing cancer causing asbestos to countries like India. Nuclear waste may be just sent for storage. Population around industrial areas is getting affected by the pollution outside factories. Has the Bhopal disaster opened our eyes? The Garg Committee report on industrial pollution in Bombay was mischievously used by the managements to close down plants. As a trade union or a community group do we not have responsibility towards the population around the factories? Why do the unions not insist on reduction in pollution? Otherwise under the excuse of protecting the environment, factories will be closed down by managements, workers will be isolated and lose their source of livelihood.

The managers of production do not want either workers or society to enter the above areas of what and how to produce. This area needs to be included in the perspective of the trade union and consumer movement not only as a distant goal but as an area of intervention for today's activity.

History of labour legislation in India

Only religion and tradition guided the relationship between the worker and the employer in ancient days. A worker was expected to remain faithful to the employer and the concept

of salt was popular. In Muslim society, it was said that the worker should get his wage before his sweat vanishes from his forehead. Among Hindu and Christian philosophies the employer was expected to be a considerate guardian. All these good or bad dictums were prevalent with the sanction of society but no legal entity was there. It was easy to maintain a relationship as a large labour force was not employed at one place. It was only after the industrial revolution that peasants migrated to towns to build a workforce. There was a shift from agricultural society to industrial society. In agriculture, labourers and landlord were usually from the same village and there were checks and balances created by society on both. With migration, this control vanished and laws were felt necessary. Charles Dickens wrote novels (e.g. Hard Times) to depict workplace conditions. In fact, when the pictures of underground miners were printed in British newspapers, it created unrest in society. At this stage, need was felt to make laws to regulate the conduct of employers. Fixed working hours, a weekly day off and just wages were a totally unknown concept up to the middle of the nineteenth century. The situation was not only exposed by Charles Dickens but also by Karl Marx and Charlie Chaplin.

Organised legislation started in India with the establishment of British rule. The rulers were clear about their objective of safeguarding the interests of capitalists as they were colonial rulers. So most of the laws made earlier safeguarded not the labour but the owner. The breach on the part of the labour of any condition was considered to be a criminal offense and this was the beginning of labour laws in India where the assertion of a worker's right was a criminal act. The history of labour legislation can be traced from 1834-1838 when the Government of India felt it necessary to regulate recruitment, employment and deployment of Indian labourers to the various British colonies. The country was then semi-feudal in its character and the doctrine of laissez-faire was followed. It was believed that any interference in the employee-employer relationship would be detrimental to the employee as well as to the employer. Far from protecting the interest of labour, the first attempts to 'regulate' labour consisted of enactments, such as Assam Labour Acts, the Workmen's Breach of Contract Act of 1859, and Employers and Workmen's Dispute Act, 1860, under which workmen were held criminally responsible for breach of contract.

After the start of the labour movement in Europe, the publication of the writing of Marx and Engles and the developing trend of the intellectuals in favour of labour created an impact on the British government in India since the international thought process was changing. Towards the close of the twentieth century, efforts were made to enact legislation which protected the workers interest. Pressure was also exerted by the factory owners in England as they felt that their counterparts in India benefited by the absence of regulations and could produce cheaply whereas in England they had to take care of labour costs. The Factories

Acts of 1881 and 1891 limited the employment and working hours of women and children in factories. The Mines Act of 1901, secured safe conditions of work. The Act of 1911 removed some of the shortcomings in the existing laws and was thus another step towards strengthening the position of labour.

However, after the First World War, labour legislation assumed some shape. With the introduction of Montagu-Chelmsford Reforms and the formulation of the first constitution in the country under the reforms of 1919, the central legislature was entrusted with all matters concerning labour, except housing. After the war, there was consciousness among the workers ; the industrial unrest which followed evolved a workers organisation called the All India Trade Union Congress. At about the same time the International Labour Organisation was also set up. The tripartite meeting (government, employer and workers) became the order of the day.

The Factories Act of 1911, reduced the hours of work to sixty hours a week, provided payment for overtime work at the normal wage, raised the minimum age of employment of children from 9 to 12 and reduced their daily hours of work to six; it covered factories using power and employing 20 or more workers. The Indian Mines Act, 1923 which repealed the Act of 1901, restricted the hours of work to 60 per week on the surface and 54 underground, fixed the minimum age of employment of children at 12 and made provision for a weekly holiday. The other important legislations in this respect were: Workmen's Compensation Act, 1923 amended in 1929, the Trade Dispute Act, 1929, which provided for courts of enquiry and conciliation boards, and Indian Merchant Shipping Act, 1923. Indian Railways Act, 1890 was amended in 1930 to implement the I.D.O. Convention 1919, regarding the hours of work. The Indian Trade Union Act, 1926 was also enacted. Some of the provinces also enacted legislations regarding maternity benefits. The Royal Commission on Labour was also set up and in its report, recommendations were made on all aspects of labour problems in the country, such as (a) employment of women and children, (b) migration, (c), hours of work, (d), conditions of work, industrial relations etc. Under the Government of India Act 1935, the provinces were given concurrent legislative jurisdiction in respect of factories' liabilities, workmen's compensation, unemployment insurance, trade unions and industrial disputes. Some of legislations made by the province were The Bombay Industrial Disputes Act, 1938, The Maternity Benefit Act in Bengal, U.P., Punjab, Assam, Sind and, Shops and Establishment Act in Bombay, Bengal and Sind. Another important measure was the employment of a labour commissioner for dealing with labour problems in the respective provinces.

A need was also felt to have uniform labour laws; with this objective, the central government

called a conference of Provincial Labour Commissioners. Its first session was in January, 1940, and second and third were held in January, 1941 and 1942 respectively. The outcome of this conferences was the tripartite charter of meetings of the workers, employers and government.

What do the present laws say?

The provisions of our present laws are too scattered and many types of workers are not covered by any occupational health law. It may be noted that during the last decade, developed countries like USA, Canada, Sweden, etc. have revised their Industrial Acts and formulated comprehensive laws on occupational health and safety. These legislations do not challenge global occupational hazards, but at least, they ensure some protection in their respective countries.

In India, the legislations that regulate the safety of work environment and occupational hazards can be divided into three categories: Perspective-protective, curative and comprehensive. The **Perspective-protective acts** are; The Factories Act, 1948, The Mines Act 1952, The Plantation Labour Act 1948, The Beedi and Cigar Workers Act 1966. These acts prescribe specific standards for working conditions in factories, mines, plantations and beedi manufacturing industries.

The Factories Act, 1948, has laid down provisions for the general health of the workers by prescribing details about cleanliness, disposal of waste and effluents, ventilation and temperature, dust and fumes, artificial humidification, overcrowding, lighting, drinking water, latrines, urinals and spittons (Ch.III). Chapter IV of the Act provides for the safety of the employees by laying down specifications for the fencing of machinery or near machinery in motion, employment of young persons on dangerous machines, striking gear and devices for cutting power supply, prohibition of employment of women and children near cotton opening, hoist, lifts, chains, ropes, revolving machines and any other hazardous operations. It also discusses the protection of eyes, protection against fumes, explosives and inflammable gas and precaution against fire. Standard safety specifications for building and machinery are also mentioned in the Act.

Chapter IX of the Act empowers the state government to declare a manufacturing process as a dangerous operation. Any dangerous manufacturing process has to take up extra precaution for safety like periodical medical check ups. It also makes mandatory for the employer/owner to employ a safety officer to periodically assess the hazard and to remove the conditions of dangerous operations.

The Chief Inspector of Factories has the highest authority to inspect and recommend safety and health measures. Any bodily injury or accident occurring in a factory which results in absence from work for 48 hours by the injured worker has to be informed to the Factory Inspector's Office. To check the violation of any provision of the act, an inspector may take samples of substance used in the factory. He can also take up safety and occupational health surveys and recommend the same by any expert institute.

The most recent amendments identify hazardous processes. These amendments give certain rights to the workers and the citizens living in the vicinity of the industry. Both of these sections have the right to information about hazardous processes. Earlier the reports of medical checkups of the workers were the property of the management, now the workers have the right to get them. It is now the duty of the management to provide information on hazardous processes. The employer has to develop the safety policy and form a safety committee. The act guarantees that the identity of the worker will not be disclosed by the factory inspector in case of any complaint by him. The factory inspector is the only authority who can take legal action against the erring company. The rules under this act are framed by the state governments, where we find lots of discrepency. For example one chemical declared dangerous in one state is many a times not considered dangerous in other states.

The Mines Act, 1952 includes all activities related to excavation (both under ground and open cast), where the operations are carried out for the purpose of search or obtaining minerals.

The prescriptive and recommending authority under this Act is the Mines Inspector. Of course, the power of Mines Inspector does not stand in certain work processes where the number of labourers are below 50 and the purpose of work is not profit oriented.

A special section on occupational health and safety in mines was included in the Act only in 1983, but this section (9A) only talks of "facilities to be provided for occupational health survey". It delegates all power to the inspector and his office to undertake OH&S survey with due notice to the manager/owner. It clearly says that if the worker is found suffering from occupational diseases caused by the prevailing work condition, it is the responsibility of the owner/manager to provide compensation as permissible under Workmen's Compen–sation Act.

Section 10 of the Act mentions the secrecy of the information obtained from occupational health survey. No report of the safety survey and medical examination can be revealed to the public or individual worker whose health has been checked up for the purpose of the survey. But these can be revealed only on demand by the court, superior officials, inquiry

commission, Workmen's Compensation Commission, Controller and recognised and registered trade unions.

A very progressive amendment was made in 1983, which discusses the formation of a committee consisting of representatives of the government, owners, workers and qualified engineers to make recommendation to the central government for formulation of rules and regulations to inquire into different aspects of the mines, including health and safety. This committee can be formed at different levels from the national level to the individual mine level. The Act empowers the committee to exercise as much of the powers of an inspector as it deems necessary or expedient to exercise for the purpose of discharging its functions. Chapter III and IV empower the committee to intervene and stop the process of work in the case of perceived danger.

As in the Factories Act, 1948, the Mines Act specifies the provision to notify all types of accidents to the inspector. However, unlike the Factories Act, it is obligatory for the owner to notify the trade unions by putting a notice about the accident on the notice board. Regarding occupational disease, it specifies that if a doctor detecting and declaring any occupational disease fails subsequently to diagnose and prove the same to the chief inspector, he is punishable under the Act. The Act itself is a deterrent for the practicing physicians to diagnose the health of the workers from the occupational health point of view.

The Plantation Labour Act, 1951: This Act seeks to regulate the conditions of plantation labour in tea, coffee, rubber and other plantations, wherever the government feels necessary. This Act applies to the plantation work where the work place is more than five hectares and 15 or more persons are employed.

The Chief Inspector of Plantation is vested with the authority to ascertain the regulation of the Act. Chapter III, which deals with health, does not mention any occupational disease except the provision of medical facilities to the labourers and their family members at the place of work.

The Beedi and Cigar Workers (Conditions of Employment) Act, 1966: This Act is applied to all the processes of production of beedi, cigar, i.e., manufacturing, finishing, packing, transport and delivery of the goods related to the production process, use and sale.

The Curative Legislations

The Employees State Insurance Act, provides benefits in case of sickness, maternity and employment injury to the workers whose monthly income is less than Rs. 3000. The Act is applicable to all units where 20 or more workers are employed. In case of employment

injury the Act guarantees sick leave without the loss of wage. Schedule III of the Workmen's Compensation Act is applicable to the ESIS Act for claiming compensation.

Compensatory Legislation

The Workmen's Compensation Act, 1923 guarantees compensation in case of occupational injuries and diseases. It takes many years to claim compensation under this Act. Under this Act, workers/employees do not benefit if: (1) their employment is temporary in nature, and (2) the work on which they are employed is not for profit or trade of the employer. The procedure of claiming compensation is lengthy. In case of the diseases of Schedule III the worker only has to prove the necessary period of the employment and that the worker is affected by a disease in Schedule III related to his occupation.

Inadequacy of labour legislations

All the legislations discussed above are fragmented in nature. There is not a single Act which looks into all aspects of safety and health matters. In contrast the Canadian Occupational Health legislation is based on three basic safety rights viz., the right to know, the right to participate and the right to refuse. Our laws have a very narrow coverage and the workers of many occupations do not come under their purview. The workers in small sweat shops, construction workers, office workers, telephone operators, VDU operators, etc. are such examples. The ESIS Act also has a very limited scope. It is very difficult for the labourers who work in the unorganised sector and change their work frequently and where the employer is not visible, to claim compensation.

It is very unfortunate that the majority of mine and industry owners do not register the total number of employees. They do not register the total strength to more than 3 or 4, because then this saves from payments of the Gratuity Act, and also from the Factories Act. Last two decades have witnessed a process of tremendous growth of small scale, household, informal sector industry, employing a very large number of workforce (roughly 80%). Workers of this sector are not covered by any protective legislation nor is any attempt made to inquire into their health and safety. Even where they are implemented, the employers in India have the tendency to follow minimum standards of all these Acts. It is basically a game of hide and seek which is played between implementing authorities and the employer. These Acts are moulded to suit the profits by maximising the working hours and not by improving workplace and working conditions. Since most of workers of this sector are unorganised they are paid minimum wages, overworked, and exposed to hazardous working conditions. This situation is true for all kind of jobs in the unorganised sector.

Part–II

Role of Information

'Workers are negligent' is a popular slogan, often repeated by the management. This is substantiated by manipulated data. They are accused of not using the Personal Protective Equipments. But no research is done on the usefulness and practicability of PPE's. If a worker employed on piece rate basis reduces his output by wearing gloves,he will not opt for them. We have to change the very structure of the wage system before forcing the use of PPE. This is the typical example of bargaining disease in exchange of bread and butter. Similarly in hot temperature they are told to wear a mask which can lead to rashes or suffocation. PPEs are not the solutions. We must try to check pollution at the source.

Secondly, workers are not supposed to have any say in the production process. They are only in the factory to sell their labour and collect their wages. Names of raw materials are concealed on the excuse of patent or trade secret. This practice is very common in chemical factories. Decisions on the production process are the monopoly of the management and they do not allow interference from anyone.

Unions need to be well informed to support shopfloor activity on occupational health and safety. Often unions are dominated by 'educated' white collar workers who lack the understanding of production or the meaning of unhealthy processes. One such leader told me that there is increase in absentees due to rise in wage levels. The workers have become lethargic. In the same factory the working conditions were so unhealthy that four workers got paralyzed due to exposure to lead. Unhealthy working conditions are more likely to be the cause of increased absenteeism.

Lack of information is also used by the management for their benefit. Milk and eggs are given to workers working in hazardous operations. These help to increase the general nutritional levels and in this sense it is definitely a gain. But the milk and eggs do not reduce the hazardous effects of carbon monoxiden or are they antidotes for any chemical effects.

Need of workers education on occupational health

We have two types of workforce in India, viz. organised and unorganised. The organised sector contains the large industries and public sector undertakings and the unorganised sector covers the workers in the medium sector, small scale, contract workers, women and child workers. The majority of our country's workforce is unorganised.

First, let us take the case of the organised sector. We have a very long history of the trade union movement. This movement has not only contributed in the development and improvement of working conditions but as also contributed to the freedom struggle and political processes after that. But the major thrust of its demands has always been economic. Reasons may be many but the major reason is that it is easy to mobilise workers around economic gain. Tragically most of them stick to it even after the goal is achieved. Economic demands affect all the workers in the industry irrespective of their area; on the other hand problems of occupational health vary from department to department in the same industry. Secondly, the cause may be the technical nature of the subject with the absence of any agency providing neutral and user friendly educational support. Experts tend to mystify knowledge and scare off the common man.

Training of Doctors: The necessary component to identify the existence of diseases in the area are the doctors practising in the area. Not only is initiative required from the community but doctors should also see that workers get proper opportunity to educate themselves. Doctors are bound by their professional ethics in this regard They must keep all the information about the industries like raw material used, products and by-products and also the process. They must ask each patient about his occupation before reaching any conclusion about diagnosis.

Legal improvements: Until and unless the present laws are implemented, no one can suggest improvements. Therefore we must put all our efforts to see that the present rules and regulations are properly followed. Workers like construction and agriculture workers who are not covered by any legislation should be surveyed and lobbying must be done for making more comprehensive laws.

How managements can act

One has to recognise that industry is the backbone of today's society. It has to play a major role in the development of society. There is a constant and genuine demand from society at large for the safety of humans and environment. Today India is experiencing a change. This change is opening the gates of the country's industrialisation for multinationals and is also offering avenues for Indian companies to prove their worth in the world market.

In today's world of openness, safety of the workers and the people living in the vicinity plays a major role in the survival of the companies. On the one hand we find that peoples' and workers' groups are demanding the information from the companies regarding their health and safety status and on the other hand they are also acquiring the capacity to generate this information by acquiring the skills to investigate. The rising trends show that only a few

cases of the presence of occupational diseases can ruin the reputation of a competing company. If an Indian company wishes to start its manufacturing process in a foreign country, there are certain procedures which if followed, can make them more effective. There are case studies even in India about companies who have generated wealth from waste. In this part of the paper we are trying to help Indian companies not only to streamline their policies and practices and help them in reducing occupational diseases and accidents in future but also help community groups to pressurise and lobby for enforcing them. We should not enter the twenty first century with a sick and disabled workforce and citizens.

Safety, Health and Environment Policy

Every company should have a clear cut SHE (Safety, Health and Environment) policy. This policy must have wide acceptance and publicity throughout the organisation. We can ask for a written statement which affirms the employers' commitment to protect the health and safety of all persons who are affected by their operations. It not only requires the endorsement of the senior management but also support from managers and workers. Every company should try to achieve high above the minimum standards set by law, wherever possible. The policy should be accessible, posted and distributed not only to the all the employees but also to the people living in the vicinity with the help of media. The most important part of this whole exercise is that this policy be regularly reviewed and updated depending upon the changes in the nature, technology and the capacity of the company. The management must see that every aspect of health, safety and hygiene is covered. The accountability of employees should meet the employer's standard for all operations. Big corporate houses can make a joint SHE policy for their all the operations.

Occupational Health and Safety Administration

This includes a clearly defined administrative program to manage the issue of health and safety. It must not only have a clearly defined role for each level of management in the administration and for the health and safety professionals responsible for the area but also have expectations for the action to resolve the issues. Efforts should also be made to generate clear understanding among safety professionals and all levels of management about the priorities of the programs and the expectations placed on them for their successful implementation. Unsafe work culture must not be promoted and every company must have clearly defined safe work practices, workplace standards and standards of personal protective equipments. There must be a written procedure requiring proper incident/accident investigation, reporting and recording of data which clearly defines the role and duties of all personnel involved, confirming the minimum requirements of the law of the land.

There must be a well established procedure to communicate current health and safety issues to the employees that includes the following:

Information regarding the regular health and safety meetings of the management, supervisors, and local health and safety practitioners. This system can also have a necessary component of meetings involving all the employees; programs when regular health and safety inspections will take place; written communication of accident investigation reports to all responsible personnel who may be affected; build health and safety awareness with the help of films, posters, bulletins, etc., communication to employees of known or potential hazards associated with the workplace and their possible effects.

The next important component to achieve reduced accident rate is to have written plans to handle all levels of emergency incidents, including, identification of potential emergencies and personnel assigned to handle an emergency and their responsibilities in the event of accident. The company must also organise practice sessions to ensure readiness in the event of an accident.

Regular health and safety inspections must be documented by supervisors and health and safety experts. The company must also regularly review the local health, safety and work procedures to ensure compliance with current internal and legislated standards, their suitability, availability and familiarity at the workplace. This process can help in identifying and resolving the issues.

Joint employee – management health and safety committee

There is a provision of having a safety committee in industry to promote workers participation in the field of occupational health and safety. The perfect and effective committee should consist of people at all levels like senior management, operations, facilities, engineering department and the employees. This committee should perform regular health and safety inspections in the area and organise training programs to ensure that its members are up to date with information and skills which can make them more effective in their task. The minutes of the meetings should be issued or displayed for all. This can be action oriented and must have a clear cut description of the task. The committee should have power to review the task and follow up actions.

Training

Training can be provided at two levels with a standard format for supervisors and workers. Such training helps in ensuring that all operators are properly trained and properly supervised before they perform any hazardous task. The company must also see that all new employees

are given training before they join duty. The topics covered can be: job hazards, health hazards, use of protective equipments, safe and proper work procedures and restrictions, health, safety and environmental regulations, reporting of accidents and first aid. As a second step they must all remain under strict supervision until they are capable of handling the task independently and without the risk of injury.

What communities living in the vicinity can do?

The people living in and around industrial area are the major stake holders. If any thing goes wrong, it is the community which pays the price. Apart from keeping an eye on the practices of the industry the community group must also acquire the basic skills to investigate and study. Simple things like environmental and safety audit methods can fetch no result if they are manipulated, so we must educate ourselves on these issues. A record must be kept on not only the emission of the factory but also the health of the people working in it. Efforts must also be undertaken to educate the doctors practicing in the area about possible diseases and their symptoms, which can erupt.

Dr. Ashesh Kumar
PRIA

Environmental Pollution – Its causes, monitoring & abatement

Introduction

> *"Its looks like a sparkling blue and white jewel . . . Laced with flowing swirling veils of white . . . Like a white pearl in a thick black sea of mystery."*

Eader Mitchell radioed back to Housten, when he flew to the moon on board Apollo 14, way back in 1971. Twenty four years later, a dull dirty earth filled with heavy carbon, nitrogen, and sulphur filled with rotten garbage, sewerage, and filth in the water might have greeted him. A rapid pace of industrialisation coupled with uncontrolled exploitation of nature has caused dumping of industrial by-products, hazardous chemicals, nuclear wastes along with deforestation, desertification, and pollution of river basins, lakes and seas in the recent past. In his quest for wealth and comfort man has ignored the laws of nature and thus disturbed the natural cycle. In nature, each living organism has its own environment which is affected by even the slightest anthropogenic disturbance. Thus anything released into the environment which degrades it can be expressed in its real terms as "Matter In The Wrong Place" or "Environmental Pollution".

Environmental Pollution: An Overview of the Indian State

The environment pollution problems of India are massive. The country has a vast growing population, nearly 40 % of which depends on nature's gift of land, water and forests for food fuel, and shelter. They put tremendous pressure on natural resources. The general indifference of the industrial sector on the environment safety aspects, low environment literacy, a gross underevaluation of the economic and ecological aspects of biological diversity are some of the other root causes.

Further, India has several highly polluting industries. The New Economic Policy (NEP) and the growth in the industrial sector has added to the misery of the common man. Most of these industries release toxicants much higher than their permissible limits.

Water is a unique chemical essential for our survival. Its pollution is a major problem. In India, 70 percent of water sources are polluted by domestic, agricultural and industrial wastes. A recent survey of the environment by Hindu reveals that all the 143 major river systems in India have become giant sewers for the country's urban population. In India, barely 7 out of the 3000 odd towns treat their domestic sewage, the rest just dump them either into the rivers or directly into the sea. Of the over 4000 water polluting large industrial units, only half have installed pollution control units. However, more than a million small units have not even begin to think in terms of controlling pollution (Purie, 1992).

Ecology & Components of Environment

Rapid industrialisation and population explosion has resulted in the production of massive amounts of liquid and solid wastes. These wastes find their way into the nearby water sources. The normal usage of water, for irrigation, fishing and a source of drinking water purposes thus, gets impaired. With pollution in the stream, biota gets exposed to the toxicants. Environment means the surroundings of an object. The layer of earth which surrounds the earth contains oxygen which is essential for all forms of life. Our environment has four major elements/components. These are grouped as:

1. Physical Environment or non living environment
2. Biological or the living environment.

Physical environment includes, atmosphere, hydrosphere, and the lithosphere or geosphere, while the biotic component includes biosphere, the living organisms.

The Atmosphere

The air envelope that surrounds the earth is called the atmosphere. Dry air consists of nitrogen (78%), oxygen (21%) and argon (0.9%). Other gases such as carbon dioxide, hydrogen, helium, and ozone are present in small quantities. Besides these gases, the atmosphere contains variable quantities of water vapour in the lower layers. Air in the atmosphere filters out the sun's harmful ultra violet rays but allows the visible and infra red rays to pass through. The air in the atmosphere also acts like an insulating blanket preventing extremes of temperature.

Human activities have, however, caused changes in the composition of the atmosphere. The biggest changes have occurred since the industrial revolution in the 19th century, when people started burning carbon fuels on a large scale.

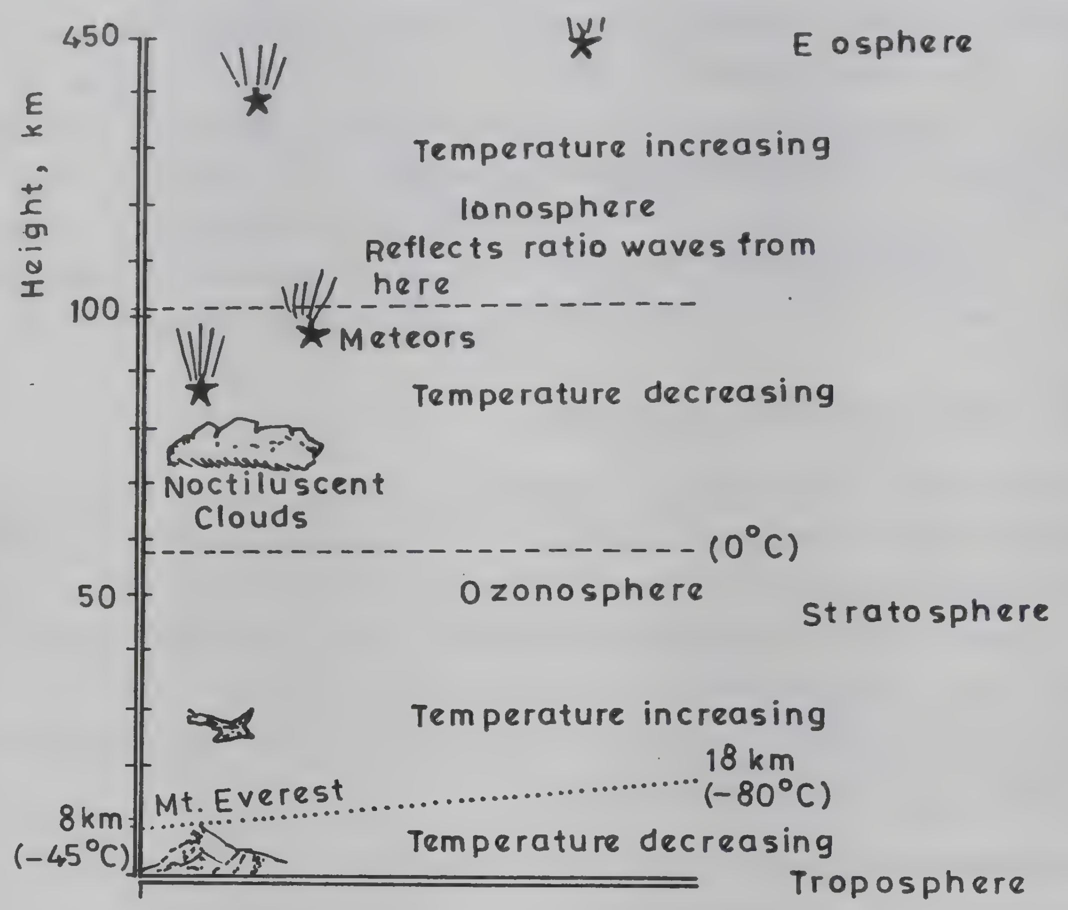

Figure 1 : Structure of the Atmosphere

(SOURCE: UNDERSTANDING ENVIRONMENT, NCERT, N. DELHI)

The atmosphere is made up of five main layers.

1. Troposphere 2. Stratosphere 3. Mesosphere 4. Thermosphere and 5. Exosphere

Troposphere – Troposphere is the bottom layer of the atmosphere. This layer stretches up 18- 20 km from the ground at the equator, and about 10 km at the poles. The upper limit of the troposphere is called the tropopause. Most of the weather phenomena take place in the troposphere.

Stratosphere – Above the troposphere is another layer called stratosphere. The stratosphere stretches upto 50-55 km. Temperature in this layer warms from about -80 degrees at the bottom to just above freezing point at the top. The stratosphere contains ozone, a gas which absorbs harmful ultra violet rays from the sun.

Mesosphere – The top of the mesosphere is about 80 km from the ground. The lower part is a little warmer because it picks up some heat from the stratosphere. The ionosphere extends above the stratosphere. This contains electrically charged particles called ions.

Thermosphere – The top of the atmosphere is about 450 km. The temperature reaches as high as 2000 degrees centigrade.

Exosphere – The uppermost layer is called the exosphere. There is no distinct upper layer and molecules constantly exit into the space.

Heat Balance In The Atmosphere : Discovery of Components of Air

1754	Scottish doctor Joseph Black finds carbon dioxide in air
1772	Scottish physician Daniel Rutherford finds nitrogen in air
1774-79	Joseph Priestly (English) and Antonie Lavoisier (French) find oxygen in air
1892-98	British scientists William Ramsay and Rayleigh find that air contains inert gases

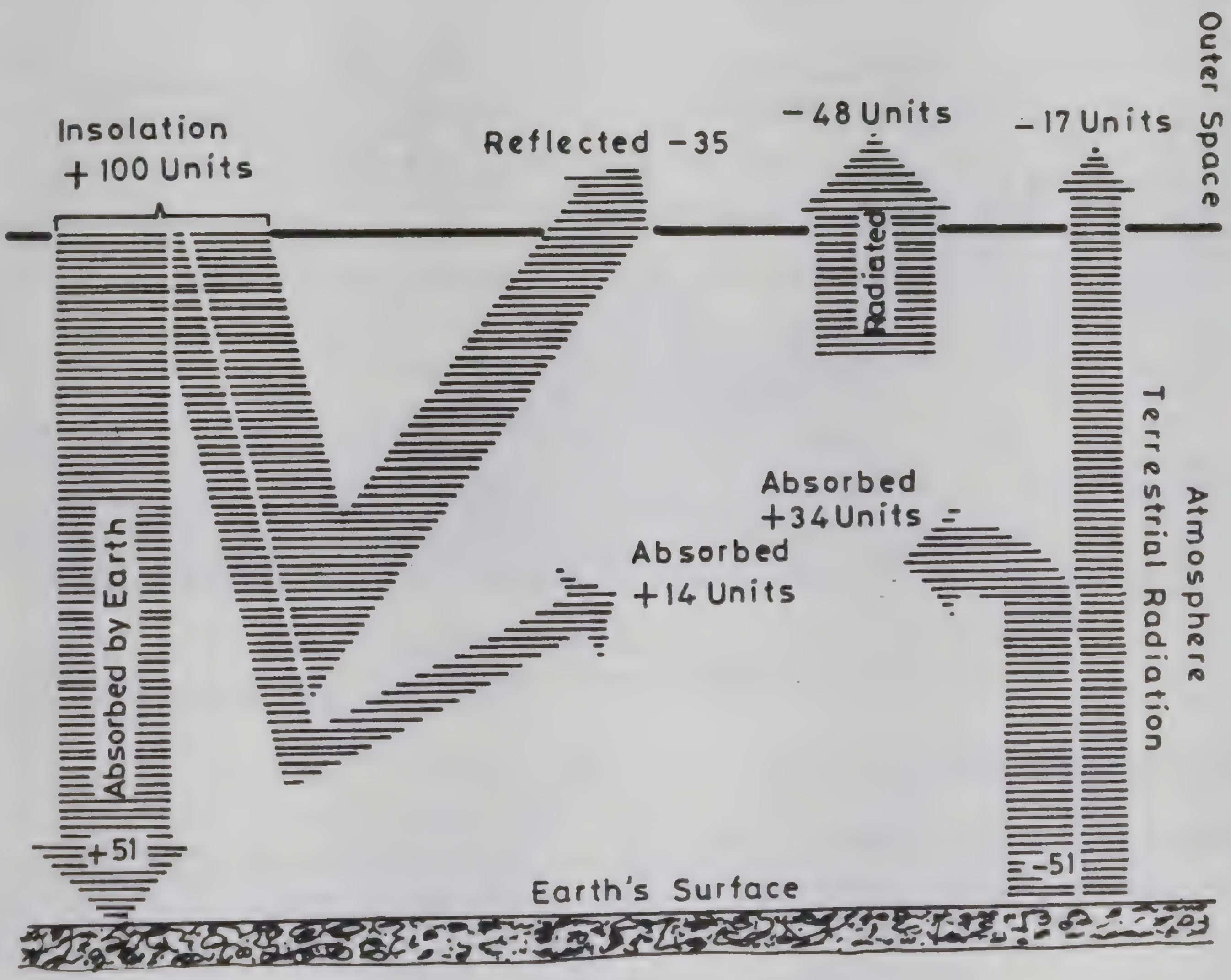

Figure 2 : Heat Balance of the Atmosphere

(SOURCE: UNDERSTANDING ENVIRONMENT, NCERT, N. DELHI)

The Hydrosphere

The hydrosphere refers to the layer of water on the surface of the earth in the form of oceans, lakes, rivers and other bodies of water. It covers nearly 71 percent of the earth's surface. Water is a compound of hydrogen and oxygen. The human body contains as much as 75 percent water. Of the total volume of water available, 97 percent is in the form of oceans, 2 percent is stored in the form of ice sheets and less than one percent is available as fresh water.

The Hydrological/Water Cycle

Heating by the sun is responsible for the circulation of water in the atmosphere. Water moves constantly from ocean to air, from air to land and from land to ocean again. This circulation of water between hydrosphere, atmosphere and lithosphere is called the hydrological cycle. A number of subcycles also operate within the process of wider circulation.

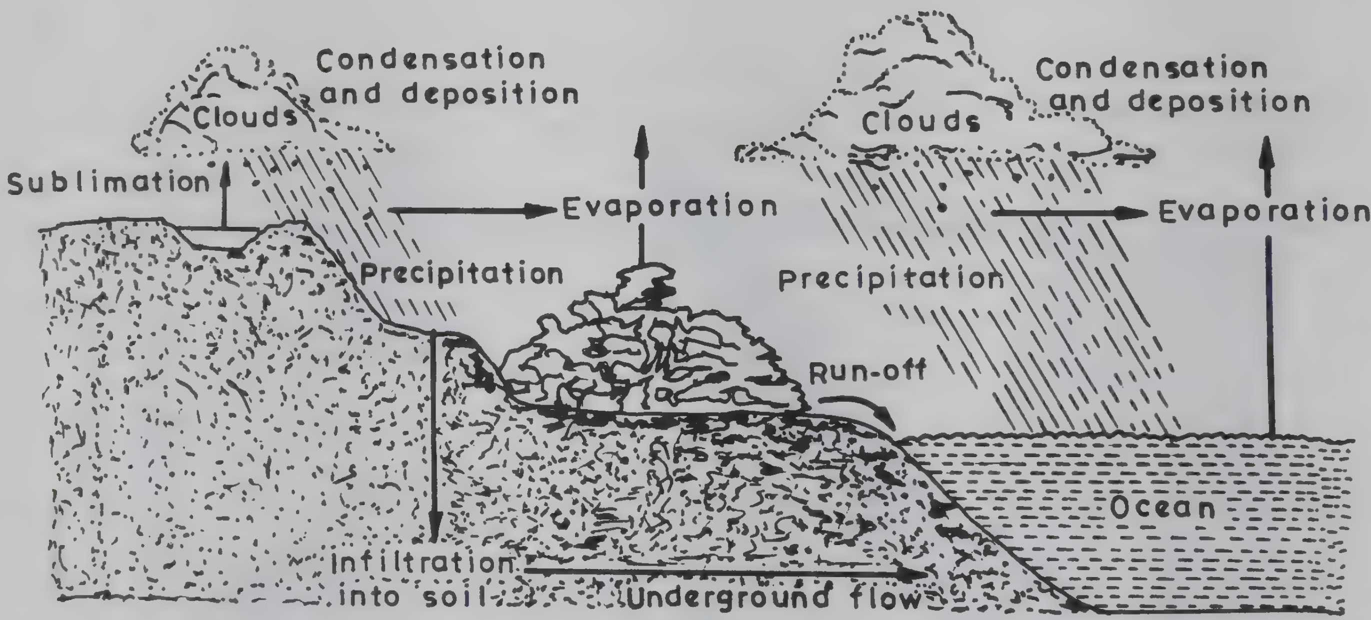

Figure 3. Hydrological Cycle: Operation of Various Inbuilt Subcycles

(SOURCE: UNDERSTANDING ENVIRONMENT, NCERT, N. DELHI)

The Lithosphere/Geosphere

The earth consists of a central core surrounded by a mantle and the outer layer of the earth's crust. The crust and the upper mantle are made up of rigid plates which float over denser material. Internal heat provides energy for the movement of these plates, causing movements of earth such as folds, faults, earthquakes, and volcanic activity. A variety of physical processes take place and these include weathering and erosion. Soil cover at the outermost surface facilitates growth of plants and provides food for living creatures on the earth.

The earth's crust consists of various types of rocks. Rocks are made up of minerals which are naturally occurring solid materials having definite chemical composition.

Rocks are classified into three major types on the basis of their mode of origin.

Igneous rocks/ primary rocks are formed by solidification from a liquid state. These are formed by the gradual cooling of volcanic eruptions, for example, basalt and graphite.

Sedimentary/secondary rocks are made up of sediments deposited gradually on the floor. Sediments may consist of particles of sand, silt, or clay. Sedimentary rocks contain remains of plants and animals (fossils).

Metamorphic rocks are formed by change of form of pre-existing igneous or sedimentary rocks. For example, lime stone gets converted into marble, sandstone gets metamorphosed to quartzite.

The Biosphere

It is the living part of the planet and includes atmosphere. Bios is a greek word meaning life. Biosphere extends a little above and below the planet earth.

Ecosystem : Plants, animals and other organisms together with the physical environment with which they interact constitute the ecological system or ecosystem. It contains several habitats. Each organism in the biosphere has its own characteristic physical environment, its habitat.

Cycles in the Biosphere

Nutrients in the environment transfer from one phase to another phase. Living things take in water, carbon, nitrogen, and oxygen and use them to live and grow. All organisms grow, die and decompose. Decomposition releases the substances in their bodies back into the biosphere to be used again.

Carbon Cycle

Carbon comes originally from carbon dioxide in the atmosphere. Green plants and some bacteria take this and use it to make food. When animals use plants, they take in some of the carbon. Carbon dioxide goes back into the atmosphere when living organisms breathe out or when they produce waste, die and eventually undergo decomposition.

Oxygen Cycle

Living organisms take in oxygen from the air. They use it to release energy from the food

they eat. New molecules are made with carbon, hydrogen, and nitrogen. Oxygen is released back into the atmosphere by green plants during photosynthesis and by living organisms as a part of carbon dioxide.

Nitrogen Cycle

All living organisms need nitrogen to make proteins. Most of the biological organisms including humans are not capable of taking it directly from the atmosphere. For these organisms, nitrogen has to be fixed or combined with other elements in the form of nitrates or nitrites. Fixation of nitrogen is carried out in the soil by nitrogen fixing bacteria, algae and lichens. Plants can take nitrogen in the form of nitrates and animals get nitrogen by eating plants. Denitrifying bacteria break down animal waste and dead plants and animals to release nitrogen back into the atmosphere.

Components of Ecosystem

An ecosystem consists of

1. Non living or abiotic component and
2. Living or biotic component.

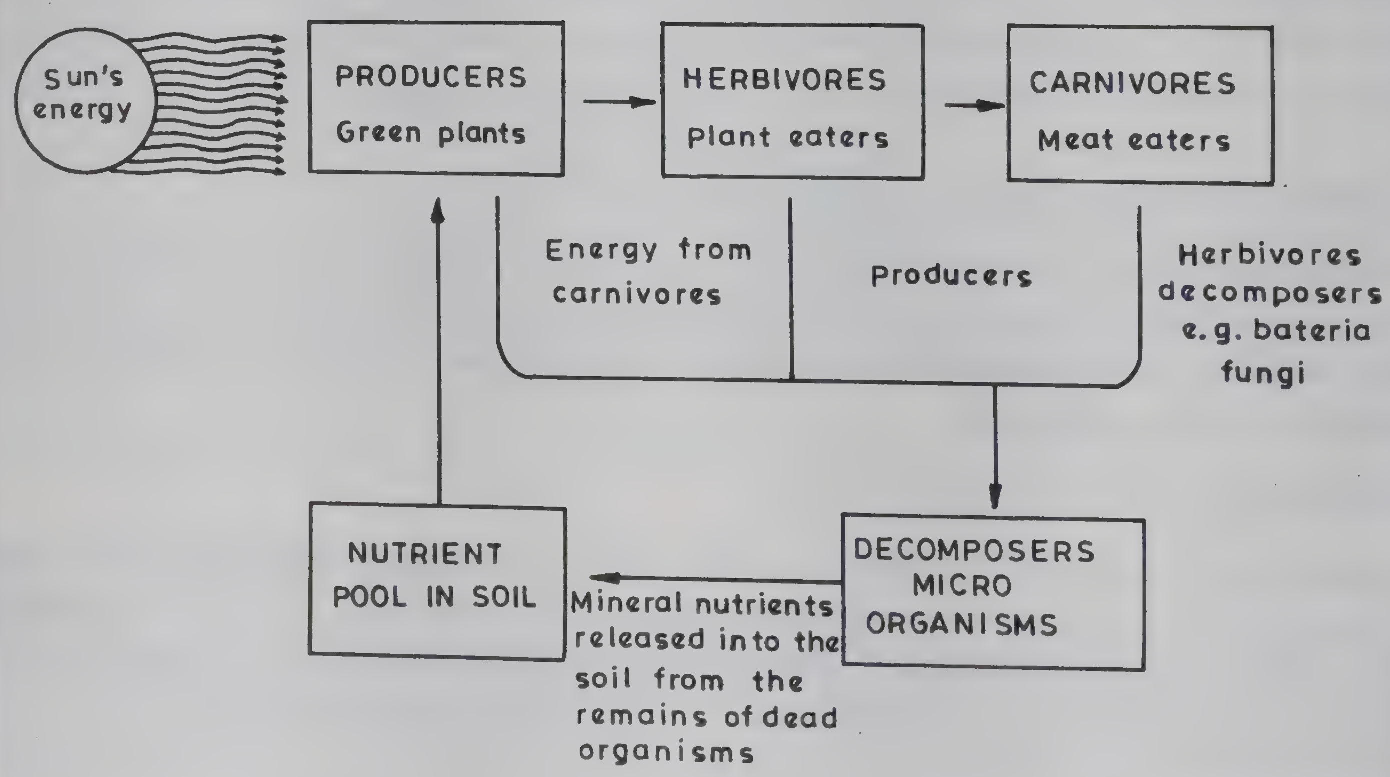

Figure 4. Energy and Nutrient Cycles in an Ecosystem

(SOURCE: UNESCO)

The non living component consist of chemical substances in the soil, water and atmosphere. These include inorganic substances like water, oxygen, carbon dioxide, and minerals like phosphates, nitrates etc. and the organic substances like carbohydrates, fats, proteins, and vitamins. Other abiotic elements include temperature, rainfall, duration of sunlight, nature of soil, and composition of water bodies.

The biotic components are broadly divided into two major groups- the producers and the consumers. The producers are organisms which produce their own food from the physical environment. These are called autotrophic organisms e.g. green plants through photosynthesis produce carbohydrates.

All other organisms are called consumers or heterotrophic organisms as they depend on other organisms for food. An organism that feeds only on plants is called a herbivore or primary consumer. A consumer that feeds only on animals is called a carnivore or secondary consumer. The humans are omnivorous. A group of organisms which feed on dead and decomposed tissues are called decomposers, for example, micro-organisms.

Food Chain And Food Web

In an ecosystem, each group of organisms occupies a particular trophic level. All green plants occupy the first trophic level. Herbivores which feed on plants occupy the second trophic level. Carnivores that eat herbivores are at the third trophic level. Thus in an ecosystem, living organisms are linked through a series. This series of transfer is known as a food chain. The different trophic levels are not equal in terms of energy levels and trophic levels are represented in the form of a pyramid known as Ecological Pyramids. Further, in cases where organisms eat a variety of other organisms, the food chain becomes more complex. This complicated network of food chain is called a Food Web. The percentage of energy transferred from one trophic level to another is called ecological efficiency. It normally varies from 5 to 20 depending on the type of organisms and environmental conditions.

Environment Pollution: Monitoring & Control

Depending on the type of waste discharge, pollution can be categorised into the following types:

1. Water Pollution
2. Land Pollution
3. Air Pollution
4. Noise Pollution

Land Pollution

Land pollution results largely from the disposal of solid wastes of municipal and industrial origin. In India, dumping of such wastes on low lying areas is a common phenomenon. Dumping of wastes causes toxic materials to be leached into the soil which affects ground water course. In Bombay alone, an average of 4,000 tones of refuse and 2,000 tones of debris are produced daily. The city of Delhi generates 4000 tones, Bangalore 850 tones, Ahemadabad 1,280 tones and Calcutta 3,150 tones (The Hindu, 1995). It is quite clear that the most serious problem confronting urban settlements is "How to handle enormous amounts of debris, garbage and rotten non biodegradables produced in the form of solid waste?".

Air Pollution

Air pollution refers to an imbalance in the quality of air which causes ill effect either to the living or non living components of the ecosystem. Air pollution is mainly attributed to the undesired presence of gaseous pollutants and particulate pollutants.

1. *Gaseous Pollutants*

These include carbon monoxide, oxides of sulphur, oxides of nitrogen, hydrogen sulphide, organic sulphide, and various other secondary pollutants.

2. *Particulate Pollutants*

Suspended Particulate Matter (SPM) in the form of dust particles,smoke, mists, fog, fumes etc.

3. *Natural Pollutants*

Pollen grains, products erupting from volcanic eruptions.

Air pollution affects human health in various ways. It particularly damages the respiratory system. Lung cancer, bronchitis, emphysema (enlargement of air vesicles of lungs) and asthma are some of the chronic diseases which are caused due to exposure of polluted air.

Agricultural Waste Effluents

These include, fertilizers, pesticides, farm and animal wastes. Excessive application of fertilizers add nitrogen, phosphorus and potassium which are easily transmitted to ground water by reaching surface water through natural drainage and run off. Pesticides include insecticides, herbicides, fungicides, rodenticides, algaecides, molluscides, acaricides, and

nematocides. Release of traces of pesticides and their metabolites in water damages its biota and results in gross pollution of water bodies.

Animal wastes also pose problems of odour and water pollution. Animal wastes which enter into water bodies with surface run off create nuisance and filth.

Domestic Waste Effluents

Untreated waste effluents are discharged into water bodies. These wastes carry high concentrations of inorganic and organic loads. Addition of untreated domestic waste impairs water quality and leaves it unfit for further use.

Industrial Waste Effluents

Industrial activities generate a wide variety of waste products which are generally discharged into water courses. The principal industries which affect environment include pulp and paper industry, textile industry, food processing industry, chemical industry, petroleum industry, heavy engineering and automation.

Summary of methods for water and wastewater analysis:

1. Gravimetric Analysis- Uses weight differences in the sample by evaporation, filtration or precipitation. e.g. in the measurements of solids, volatile matter, oil and grease, sulphate etc.
2. Volumetric Analysis- Measurements through volumes of known strength.
3. Micro- Analytical Analysis- Micro analysis of metals, organic compounds is done using instruments like, AAS, ICP, GC, GC-MS, HPLC, HPLC-MS, ICP-MS etc.

Noise Pollution

Noise is an environmental pollutant. Workers exposed to elevated concentrations of noise suffer from impairment of hearing capacity, and other physiological and psychological stress. Noise pollution results in high rate of accidents and decrease in productivity.

Environment Disasters: Learning From The Past Experiences of Pollution Disasters

1953-60	Mercury poisoning in shellfish in Minimata Bay, Japan caused brain damage of the native people
1976	Herbicide leak in Seveso, Italy poisoned hundreds of people. Domestic animals in the area were killed.

1984	Methyl Isocynate leakage from Union Carbide Factory, Bhopal, India. 2,500 people died, thousands were affected.
1986	Nuclear reactor accident in Chernobyl, Russia. Radioactive poisoning in the area.
1989	40,000 tons of oil spilled in Alaska. Thousands of animals died.
1993	80,000 tons of oil spill in sea of Shetland islands, Scotland. Farms and beaches affected. Danger to wildlife.

Major Chemical Disaster in India After Bhopal Gas Tragedy:

Dec., 1985	Shri Ram Food & Fertilizers, Delhi	Oleum Gas Leak
Jul., 1987	Bhorari Industrial Area, Pune	Sulphur Trioxide Leak
Nov., 1987	Beharampur Ahemadabad	Ammonia Gas Leak
May, 1988	Deese Ton, Ahemadabad	Acid Tanker Accident
Oct., 1989	Chlorinators India, Gangam	Chlorine Gas Leak
Nov., 1990	India Petro Chemicals Ltd., Nagothane	Gas Explosion
Nov., 1991	Dhanu, Maharashtra	Chemical Explosion
Apr., 1992	Naya Bazaar, Delhi	Chemical Explosion
Sep., 1992	National Fertilizers Plant, Panipat	Ammonia Gas Leak
Mar., 1993	Century Towers, Sahad	Sulphuric Acid Leak
Oct., 1994	Fire Crackers Factory, Jhansi	Explosion in factory

INDUSTRIAL POLLUTION CONTROL

Air Pollution Control

1. *Particulate Matter* – The particulate matter is separated by using a combination of settling chambers, bag filters, cyclone separators, scrubbers, electrostatic precipitators, depending on the contaminant. dust load and their particle size.

2. *Nitrogen Compounds* – Oxides of nitrogen in gas streams may be absorbed by water in bubble towers, spray towers, venturi scrubbers etc. Nitrogen dioxide is easily absorbed by water but if nitric oxide is present, air or oxygen must be added and space must be provided for gas phase oxidation of nitric oxide to nitrogen dioxide.

3. *Sulphur Compounds* – If concentration of sulphur compounds is low as in power plant fuel gases, the gas is scrubbed with an alkaline solution such as limestone or chalk slurry.

A catalytic oxidation process to convert SO_2 to SO_3 (and subsequently to H_2SO_4 can also be used. Chemical absorption of SO_2 in K_2SO_4 solution to form potassium bisulphate can also be used. Molten mixture of lithium, sodium and potassium carbonates with SO_2 in the stack results in the formation of sulphates and sulphites of these metals. Stacks are suitably designed so that the height provided ensures that ground level concentrations of SO_2 does not exceed the permissible limits. Any type of liquid gas contractor can be used for the removal of H_2S. Spray towers and packed towers are used for high volumes of gases. Jet and cyclone scrubbers are used for smaller volumes.

When concentrations of sulphur compounds are high (5% to 10%) as in smelter gases then it is converted into H_2SO_4 e.g. in nonferrous metal industry like copper and zinc, SO_2 can be recovered as H_2SO_4.

4. *Carbon Compounds* – Hydrocarbon emissions may be controlled in floating roofs, pressure tanks or vapour recovery systems. When present in high concentrations in the gas steam, they can be recovered using suitable solvents. The other method is direct burning of HCs if a flame can be sustained. If flame can not be sustained, catalytic burning using platinum as a catalyst may be done to control hydrocarbon emissions to the atmosphere. The most common method of removing CO is to burn it to CO_2. The heat evolved in the process may be recovered economically. Where concentrations of CO are too low to sustain a flame, catalytic oxidation may be done in the presence of hopcalite (formulation of manganese oxide and copper oxide)

5. *Chlorines And Halogenated Compounds* – Vent gas with chlorine can be controlled by absorption in caustic soda or milk of lime. Hydrogen chloride and halogenated organic compounds can be removed from gas streams in the scrubber or spray towers. For HCL, water may be used as a solvent. Diluted acids can be circulated in the scrubber to get the concentrated acid. Low concentrations of halogenated compounds can be removed from air streams by activated charcoal adsorption.

6. *Hydrogen Fluoride And Fluorine Compounds* – Hydrogen fluoride and fluorides have an affinity for water and alkaline water. Scrubbing equipments like packed towers and spray towers can be effectively used. Caustic soda can be used in case fluorine is present. If the contaminant is present as particulates, the equipment described for particulate emission control can be used.

Air Pollution Control Equipments

Stacks – The stacks discharge to the atmosphere is the common industrial method of disposing gases. Stacks are effective in lowering the ground level concentrations of pollutants

although they themselves do not reduce the level of contaminants. In some cases use of stacks is the most economical and practical way of dealing with the air pollutants.

Type of plume and the degree of diffusion helps in determining the height of the stacks. Stacks are designed either for the emission of waste gases or their burning at the top of the stack. Depending on the pollutants and meteorological conditions stacks can be more than 100 meters high.

Electrostatic Precipitators – Electro-precipitators are of two types- pipe type and plate type. Pipe type consists of a grounded pipe or cylinder at the centre line of which high voltage electrodes are positioned. The gas flows parallel to the high voltage pipes and dust gets deposited in the inner walls of the grounded pipes. This dust is subsequently removed by rapping. The plate type electrostatic precipitator consists of parallel vertical grounded steel plates called as collecting electrodes together with an array of parallel discharge wires. The gas with solid particles passes between the plates.

A mechanical system precedes the electrostatic precipitator to take care of the larger diameter particles. Electrostatic precipitator is effectively used to remove submicron particles though this is commonly used for maximum particle size of 20 micron.

Gravitational And Innertial Separation

In gravitational separation the particulate matter is separated by the action of gravity or due to the inertia of the particles.

Settling Chambers – Particulate matter settles down when velocity of the dust loaded stream is lowered. Settling chambers are used as precleaners and particles with a size of more than 100 micron are effectively removed.

Dynamic Separators – Centrifugal force is used to separate the dust particles. Dust particles are collected in a precipitator.

Cyclones – Cyclone consists of a cylinder with a gas entry with inverted cone attached to the base. Whirling motion at the entry point causes the particles to be thrown towards the wall on which they collect and slide towards the conical collection.

Filtration – Filters are used to remove particulate matter, dust, mists and fumes. Fibrous mats and aggregated beds, paper fabric are the common filter media used in the industry.

Liquid Scrubbing – Soluble gases and particulate contaminants in a gas stream are removed by its contact with a suitable liquid. Scrubbing media needs to be treated in the end before its discharge into the environment; hence an air pollution problem is converted into a water

pollution problem. A good contact between the scrubbing media and the contaminated gas improves the removal of the contaminants from the gas.

Air Pollutant	*Solubility in Water*
Ammonia	High
Hydrochloric Acid	High
Formaldehyde	High
Sulphur dioxide	Medium
Chlorine	Medium
Nitrogen dioxide	Little
Phosgene	Little

Spray chambers – Falling drops of liquid from spray nozzles facilitate moderate contact between two phases. Coarse particles are removed with medium efficiency. Vertical tower is a common example of spray chamber.

Packed Towers – Packaging materials such as raschig rings, pall rings, beri saddlers, are used for high surface area of liquid films. The liquid is generally sprayed in the packed bed.

Plate Towers – Plate towers are less susceptible to plugging, work efficiently at temperatures than packed towers. Weight is less than packed towers. However, they cost more initially.

Orifice Scrubbers – Gas velocity is used to provide the dispersal of the scrubbing media and turbulent contact with the scrubbing media.

Venturi Scrubbers – Venturi scrubbers effectively remove water soluble gases depending on the liquid to gas ratio.

Adsorption on Solid Surfaces – Activated carbon and molecular sieves are two common methods of removing contaminated gases or vapours through adsorption. Adsorption is used to remove odorous contaminants and organic solvents. In physical adsorption, multiple layers of adsorbed molecule accumulate on the surface of adsorbing material. In polar adsorption, removal is based on polarity of the adsorbate. Synthetic zeolites are absorbents who have the ability to segregate molecules based on the shape of the absorbed molecule. Chemical adsorption results from a chemical reaction between the adsorbate and the adsorbant.

Thermal Decomposition – If the waste gas stream is combustible, thermal oxidation can be used. The process can be used for toxic and harmful vapours or dusts. Toxic inorganic compounds like CO, NOx, SOx, HCl, are sometimes produced during combustion. The combustible contaminant should be maintained below the lower explosive limits.

Water Pollution Control

For the treatment of domestic and industrial waste the following techniques are employed.

Domestic Waste Water

The following steps are followed for the treatment of domestic waste water.

1. *Screening* – Screening is done with the help of screens fitted with R.C.C. channels. Mild steel bars have little spaces which remove rags, pieces of paper, plastics etc. Screens are cleaned manually or mechanically.

2. *Grit Removal* – Grit removal tank is either rectangular or circular in shape. Grits settle at the bottom. Screw conveyors or reciprocating classifier mechanism remove grits. From conveyer the grit falls into a bucket which is periodically trucked away for dumping or disposal at a suitable place.

3. *Primary Clarification* – Sedimentation tank or primary clarifier, removes suspended solids. Suspended solids normally settle down at the bottom in 3 hours time. Continuously moving rake mechanism collects solids. From the bottom solids are taken out as sludge. Clear effluent from the top goes for the biological treatment.

4. *Biological Treatment* – Biological treatment of the waste water is done to remove organic waste in the form of BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand). It is accomplished by treating the waste by the following methods.

   a. *Aeration* – Oxygen is supplied into the waste by mechanical surface reactors in which diffuse air are used. Rotating mechanical aerators pump water and splash it into the air to come in contact in air. Effluent which comes in contact absorbs air which is consumed by bacteria. Bacteria eat organic matter in the waste and multiply and die. Dead bacterial waste is settled in another tank and is called organic sludge. The biomass which is produced in the aeration tank due to bacterial presence is termed as Mixed Liquor Suspended Solids(MLSS). After aeration MLSS settles at the bottom from where part of it is used as seed while rest is dried on sludge drying beds. In the aeration process thus, BOD is reduced. As BOD reduces COD also reduces proportionately.

   b. *Trickling Filters* – Trickling filters or bio-filters or bio-towers are shallow in depth, filled with stone or plastic media. For treatment, effluent is sprayed through rotating pipes in the filters. This results in the formations of a biological layer or a bio-film on the stones. This film consists of bacteria which eat organic matter.

c. *Oxygen Ditches* – It involves aeration of waste water. Waste effluents are splashed into the air. Bacteria in the effluent receives oxygen, and converts organic matter into inert mass which settles at the bottom and drains off.

d. *Biological Contractors* – Large rotating discs which have synthetic material wrapped are continuously dipped into the effluent. The bacteria which grow on the surface of the disc eat up organic matter.

5. ***Clarification of Effluent Water*** – Aerated liquid containing dead bio-mass settles at the bottom of final clarifier. 3 hours time is sufficient for biomass to settle. From the final clarifier, treated or clear effluent flows from the top to the outlet.

6. ***Disinfection*** – Chlorination is normally done to disinfect before treated waste water is finally discharged to the receiving body. A dose of approx. 8 mg/l of chlorine is applied with a constant period of about 1/2 hour. It results into 1/2 mg/l chlorine in effluent.

Industrial Waste Water

In addition of the normal steps given for the treatment of domestic waste water, the following extra steps are required.

Removal of oil & grease – Oil & grease is removed with the help of oil water separator. Free oil is skimmed off at the top. Emulsified oil is removed with the addition of chemicals which render it to float at the top and is removed by air flotation.

Equalization – Neutralization - industrial effluent varies in its characteristics. Equalization tanks have 2 to 24 hours of detention time. Acid or alkali is added to neutralise the effluent and proper mixing is done and water is homogenized.

Clariflocculation – After equalization and neutralization, waste is pumped to a mixer where chemicals like alum, poluelctrolite are added and waste is supplied to flocculator. In the clariflocculator, coagulation of the particles is done. Flocculated effluent is then transferred to clarifier zone of clariflocculator where it settles as sludge. For the treatment of industrial water, clariflocculator is normally used instead of clarifier. Clarified effluent from the top goes for biological treatment.

Tertiary Treatment – It is required for the removal of extra nitrogen. Nitrification, denitrification fall under the tertiary treatment. If metals or phenols are present, special treatment is done.

Anaerobic Treatment of Waste Water – Anaerobic bacteria which grow in the absence of oxygen are used for anaerobic digestion of organic waste in the effluents. Organic matter

disintegrates into carbon dioxide and water. Biogas (methane) produced can be used as a fuel gas. Wastes with high BOD and COD like distillery and pulp and paper water is suitably treated with anaerobic digestion.

Environment Pollution Control Industry In India

Pollution control industry in India has experienced and will maintain a growth of 20 percent with 40 percent profits. Stricter environmental laws could provide pollution control companies with a Rs. 4,500 -crore market. A large number of private sector manufacturers are beginning to manufacture pollution control equipments in-house. The total size of this industry as of today is 1050 crore from which 50 percent comes from small scale sectors. The average cost of a pollution control system varies between 5 and 7.5 percent of the capital cost of a new product. These industries offer solutions both for water and air based problems by waste treatment and recycling technology. The industry emphasizes on retrieval of useful products from waste matter e.g. production of electricity and production of useful chemicals. Efficient use of separation processes is another area pollution control emphasises specifically. Use of liquid solid separation processes, field application in removal of useful materials from wastes of mining(copper, zinc aluminium etc.) and in the sugar, paper, and pulp industries, nitrogen rich manure from food and dairy based industries, fly ash as a substitute for clay in making bricks, red mud from aluminium plants and phospho-gypsum from fertilizer units have been used for construction. The industries like Western Plaques, Western Bio Systems, Ion Exchange, TTG Industries, Flakt India, ABB Environmental Company, Hindustan Dorr Oliver Etc. are effectively involved in finding and offering solutions to the problems of industrial wastes.

GREEN DEVICES

Filter – A bag or cartridge that arrests dust and other particles. Efficiency – 98 Percent

Electrostatic Precipitators – Particles are negatively charged and they are deposited on a positively charged plate. Efficiency- 99.9 Percent

Bacterial Digestion And – Increases oxygen level in municipal, Areation distillery, and paper mill effluents

Pre Chemical Treatment – Breakdown non biodegradable organic waste from industrial wastes, e.g. dye plants

In a country where 70 percent industry does not meet the existing standards of emission of wastes, pollution control assumes greater interest. United States Agency for International

Development has provided a grant of 25 million dollars to the Indian government for pollution control activities. Out of 1,641 large and medium scale units identified by the Ministry of Environment, just 117 companies comply with emission and effluent control norms.

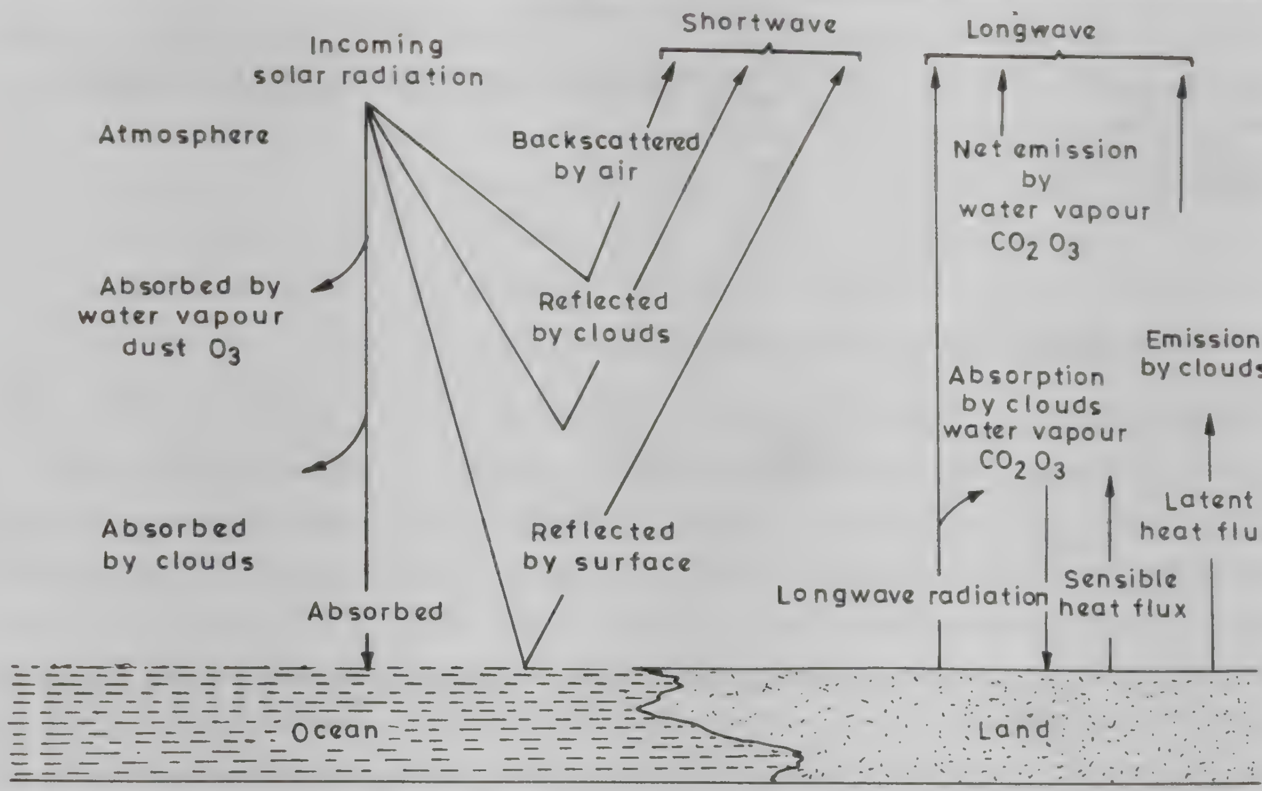

Figure 5

(SOURCE: OUR FUTURE WORLD NATURAL ENVIRONMENT RESEARCH COUNCIL (U.K.))

Status Of Pollution Control in Indian Industries

Industry	*No. Of Plants*	*Compliance of Emission Standards*
Oil Industry	12	6 (50.0%)
Fertilizer Industry	110	49 (44.5%)
Thermal Power Plants	70	25 (35.6%)
Integrated Iron and Steel Plants	7	6 (85.7%)
Cement Industry	94	62 (66.0%)
Pulp & Paper Industry	336	118 (35.1%)
Sugar Industry	365	180 (49.3%)
Distillery Industry	176	74 (42.0%)

Dr. G.D. Agrawal
Gramodaya Vishwa
Vidyalaya, Chitrakoot

Dust and Occupational Diseases in India

1. Dust, The Most Critical Air Pollution in India :

1.1 While excessive emission of gaseous air-pollutants like SO_2 NO_x CO_2,HC, CFC etc. in highly industrialised countries of the west have resulted in environmental problems like acid rain and ozone-layer-depletion and created apprehensions of global warming and adverse climate changes, much less attention has been paid during recent years to the silent and slow, but continuous and potent killer that is air-borne dusts. Even in our own country episodes like the MIC leak at Bhopal, the oleum tank failure at Delhi and gas-leaks of ammonia, chlorine, CO, etc. attract so much public attention that air-pollution in the public mind, appears synonymous with gaseous air-pollution or gas-leaks. Air-borne dusts, or Suspended Particulate Matter (SPM) are almost always ignored. Thus when expert committees consider the discoloration and pitting of Taj Mahal's marble exterior surface, they stress on SO_2 and other gaseous pollutants and ignore the role of the high SPM present which could be seriously involved both in discoloration and pitting of the marble surface, as they are definitely involved in, as major contributors to, respiratory diseases in India.

1.2 With significant amounts of monitoring data now becoming available in India, it is an obvious fact that SPM is the air pollutant of greatest concern (probably the only air pollutant of real concern) in ambient air-quality in India. This would become clear from Table - 1 giving a range of ambient air-pollutant concentrations observed at different locations in India during 1991. While SO_2 and NO_x concentrations at all locations were most of time well below the Indian (and even WHO) prescribed levels, the concentrations of SPM (or air-borne dust) almost always exceeded even the liberal Indian standards, what to say of the WHO limits. This was particularly true for the northern Indian plains, at least partly due to the warm, dry and windy climate, denuded vegetation and friable, dusty soils, but the poor condition of roads and poor dust control practice in mining and industry are bound to play a major roles as shown by the much higher SPM values in case of Barauni, Kanpur, Nimbahera, Bokajan, Delhi, etc.

1.3 Suspended Particulate Matter, SPM, as monitored by the EPA design High Volume Sampler includes all air-borne particles of 0.5 to 100 microns particle size. All of these are not relevant from the point of view of respiratory diseases, since particles above 10 microns size are not able to enter human breath. Because of their larger weight, they do not get sucked up with the normal breathing velocities. That is why now separate limits are prescribed for the respirable dust particles finer than 10 microns size, called PM_{10} in western parlours. In fact even particles between 5 and 10 microns in size are retained in upper respiratory tract of humans and only those finer than 5 microns reach the lungs. Thus mine-safety officials normally consider only the fraction finer than 5 micron as respirable and of concern. Of this also, it is only particles in the range 1-5 microns size that are likely to get lodged, retained and accumulated in the lungs, the finest ones getting exhaled with expiration. The actual health-damage or diseases caused by these particles lodging in the lungs or in the respiratory tract shall very much depend on their nature and composition. Presence of asbestos, silica, heavy metals, fibrous materials, allergens etc. very much increase their disease causing potential. Tables 2A and 2B give an idea of the differences in composition of SPM in two industrial localities. Obviously it is not merely the SPM concentrations as measured by the standard High Volume Sampler that would indicate the human health-risk but the measurement of SPM alongwith the respirable fractions as also the nature and composition of the SPM.

2. Workers the Community at Maximum Risk:

2.1 It is obvious that workers in mining, industry or even agriculture get exposed to much higher concentrations of dust as they work in areas where these dusts are generated. Drilling, blasting, excavating and material handling operations in mining, stone-crushing, grinding, milling, sieving, mixing and many such operations in industries and operations like winnowing in agriculture, release large amounts of dust and the workers face the full blast and fury of the pollutants so released.

2.2 Occupational diseases attracted the wide attention of medical and industrial safety personnel in western countries where industrial and labour labour laws and the well-accepted "torts" principle resulted in heavy compensation awards in favour of affected workers. Under pressure of such legal and compensation proceedings, intensive researches were carried out, Threshold Limit Value (TLV) for various pollutants evolved, extensive shop-floor-environment monitoring and regular health check-ups of workers were introduced and efficient and effective pollution-control and worker protection measures devised. In our own country the workers are by-and-large ignorant of the health implications of the dust, and even when they are actually suffering, of the nature or cause of their disease. They are not aware

of their legal rights and are poorly organised to generate effective pressures. Professionals including, doctors and lawyers prefer to take the easier course of keeping aloof or siding with the party that can pay better fees and pay fast. The most at fault is our legal system that does not accept the "torts" principle and is extremely reluctant to grant compensation. It is the aggregate result of these conditions that one finds only rare cases of dust-caused occupational diseases such as asbestosis, silicosis, byssinosis, pneumoconiosis, coal-miners lung disease etc. reported or recorded in India. With so little and poor monitoring of shop-floor environment or individual worker-exposure, and so-poor over-all management of dust in work-areas as is openly seen in all mines, crushers, mills and other work areas, we still proudly claim that these dreaded occupational diseases are well under control in our country!

2.3 Monitoring of shop-floor environment or of worker-exposure is extremely rare in India and even industrial giants like the Integrated Steel Plants, large cement plants etc. do not practice it. This author has also had only limited opportunities of monitoring shop-floor environment. But each such monitoring in a wide variety of units has always and invariably yielded dust/pollutant concentrations at many times the permissible concentrations. Obviously the staff and monitoring infrastructure of the Factory Inspectorates in different states and those of the Ministry of Labour are too miniscule to identify or indicate the severity of the situation. Periodical, notified in advance, and short-term checks, as are currently carried out by regulatory agencies, can be easily manipulated and managed. To be effective, the monitoring has to be regular, near-continuous and much more stringent. Only such intensive and extensive monitoring of work-places and of workers-exposures shall reveal the real risk to the health of the worker.

3. Diagnosis and Management of Respiratory Ailments of Workers in India:

3.1 As mentioned in para 2.2 above, respiratory occupational diseases are rarely reported or recorded in India. However this does not mean that respiratory diseases are less common amongst workers in India. Thus, of the total cases reported at ESI Hospitals over India during 1989, as many as 36% were of respiratory ailments which was more than 28% of physical injuries, 26% of the enteric disorders and 10% for other miscellaneous diseases. This is quite different from the situation in general Indian communities where enteric diseases and vector-borne disease normally outnumber respiratory diseases or injuries. Unfortunately the respiratory ailments are diagnosed by the common names of cough, bronchitis, asthma, TB etc. which entirely mask the occupational source/cause of the ailment. One would like to believe that this inadequate (and even faulty) diagnosis is more due to an easy-going approach and inadequate training in occupational diseases than any deliberate action on part of the doctors concerned.

3.2 In line with the above general approach, workers reporting with respiratory symptoms at ESI or other clinics are given general and symptomatic treatment including sulpha-drugs and antibiotics which would not be prescribed if they were diagnosed to be suffering from dust-caused diseases. Often the patient does get some relief, particularly from expectorant drugs and starts reporting intermittently and repeatedly for respiratory symptoms like breathlessness, chest-pain, cough, expectoration etc. When things look to be prolonging and becoming aggravated, chest X-rays are taken, and the capacity caused by accumulation of dust in lungs or the fibrosis generated by it, is diagnosed as indicative of TB. The worker is then put on ATT or other anti-tuberculosis drugs and often admitted to a TB-ward. With his greatly reduced resistance and lodged in a TB-ward, the worker become a TB patient even if he initially was not. Obviously ATT can not cure the dust - caused pulmonary diseases of the worker. He continues to grow weaker and weaker, until he dies of TB and/or other infections, none of which had an occupational source. So we have no asbestosis, silicosis, pneumoconiosis, byssinosis or other dust-caused respiratory occupational diseases, but we have a lot of TB incidence around our mines and industries. And TB is not an occupational disease, it is caused by poor general sanitation and is not notifiable or compensable.

3.3 To understand the realities of the situation and verify the above apprehensions, an intensive survey was carried out at Rajgangpur, Dt. Sundergarh near Rourkela in Orissa, which is briefly narrated below:

4. Preliminary Findings of the Rajgangpur Health Survey.

4.1 The May, 1994, health survey at Rajgangpur, involved intensive medical examination of 280 persons including industrial workers, housewives and general citizens by a team of 11 qualified doctors (2 faculty members and 9 students of M.D. at the Post Graduate Institution of Continuing Education in Ayurveda, Chitrakoot) alongwith 4 environmental scientists all from Gramodaya Vishwa Vidyalaya, Chitrakoot, Satna, M.P. The survey was coordinated by PRIA, a New Delhi based NGO which has been in the forefront, to scientifically examine the occupational health scene in India and to campaign for workers health and well-being. Local mobilization and arrangements were made by Sundergarh Industrial Mazdoor Union (SIMU) a constituent of CITU at Rajgangpur. The survey was carried out during May 9-12, 1994 and detailed compilation and analysis shall take time. Preliminary findings are reported in brief below.

4.2 On basis of their work-history the 282 subjects examined at Rajgangpur can be classified as given :

i.	Working at OCL Refractory	for over 15 years	:	96
ii.	–do–	for 8-15 years	:	36
iii.	–do–	for below 8 years	:	28
iv.	Working at Orissa Spinning Mills (OSM)		:	29
v.	Working at other industrial/mining Units		:	30
vi.	Working at offices, shops, businesses etc.		:	12
vii.	Housewives		:	27
viii.	Students/Children		:	24

4.3 Preliminary status of prevalence of respiratory ailments is shown in Table-3. A look at the table immediately reveals the relationship of respiratory health at Rajgangpur with occupation and the extremely alarming situation of OCL Refractory workers. While all categories of examinees not having OCL Refractory work-history, had 50-60% of the subjects free of respiratory symptoms, even in case of category C where the subjects had been with OCLR for less than 8 years, the fraction of such no-respiratory – ailment examinees fell to around 30% and this fraction was only 11% for those who had been with OCLR for more than 8 years. It appears that the respiratory tract of a person started / became adversely affected within a few years of his joining OCLR and soon he was on the road to no return. After 8-10 years working with OCLR the respiratory tract had been degraded enough for the subject to be suspected of, or diagnosed as, a case of TB and be put on ATT. This author, believes that all or almost all the examinees at Rajgangpur showing respiratory symptoms were really at various stages of dust-caused respiratory diseases, occupational health cases in case of OCLR workers and environmental health sufferers in case of others. Whether this author is correct in his belief should be clearer when detailed interpretation of this survey is completed and further confirmatory research has been done.

4.4 Observations of spirometer tests which were also conducted on all examinees at Rajgangpur also support the above findings. As given in the last columns of Table 3, the average PEF and average FEV_1/FVC values were both highest in case of OSM workers and fell significantly in case of OCLR workers with his years of exposure to OCLR environment clearly indicating the effect of occupational exposures. That these values were low in the case of housewives and students/children categories was due to poor general health of examinees and some of them not being able to properly use the spirometer. After all they live in the same polluted environment.

5. Conclusions and Recommendations

(i) The status of respiratory occupational diseases at OCLR is really frightening The situation at many mines, stone-crushers and other dust laden work-environments may be similar or worse.

(ii) Regular, near-continuous and stringent monitoring should be urgently enforced for work-environments where dusts are generated.

(iii) Thorough annual medical-check-ups of all workers (whether regular/daily wages/ad-hoc contract) at mines/industries be enforced.

(vi) To create specialised professionals, degree courses in M.D (Occupatinal Health) be started.

(v) Intensive research and training efforts be taken up for study of occupational health problems in India.

Table-I

Air Quality Status at selected locations in India (1991)

S. No.	Location	SO_2	NO_x	SPM	Respiratory	Particulates (PM10)
	W.H.O Limits	60		60	100	
	Indian Limits (for residential area)	80		80	200	75 (proposed)
1.	Ahmedabad	10 - 60		25 - 100	200 - 500	50 - 180
2.	Barauni	10 - 65		20 - 90	100 - 750	12 - 120
3.	Bairabi (Mizoram)	3 - 12		6 - 18	50 - 150	ND
4.	Bokajann (Assam)	4 - 12		6 - 20	200 - 650	ND
5.	Bombay	10 - 60		25 - 100	200 - 400	ND
6.	Calcutta	20 - 80		20 - 90	100 - 450	ND
7.	Cochin	20 - 80		20 - 90	100 - 250	30 - 135
8.	Delhi	20 - 100		30 - 120	350 - 600	70 - 220
9.	Haldia	15 - 80		20 - 90	150 - 600	ND
10.	Kanpur	15 - 50		25 - 100	200 - 650	60 - 165
11.	Kumarghat (Tripura)	5 - 20		8 - 35	100 - 200	ND
12.	Madras	5 - 30		15 - 70	100 - 200	40 - 125
13.	Nagpur	10 - 50		15 - 70	150 - 350	20 - 95
14.	Nimbahera	5 - 15		8 - 25	200 - 650	30 - 145
15.	Patna	5 - 40		8 - 70	200 - 700	ND
16.	Vadodara	15 - 70		30 - 100	250 - 450	ND

Notes : (i). All concentrations are in microgram ^{3}/m air. (ii). Values based on CPCB/NEERI/Envirotech Data

Table 2a
Heavy Metal in Ambient Air SPM near a Cement Factory

1. Copper, Cu	500 - 4160	mg/kg of SPM
2. Cobalt, Co	50 - 95	–do–
3. Nickle, Ni	75 - 180	–do–
4. Lead, Pb	230 - 430	–do–
5. Zinc, zn	Above 8000	–do–
6. Chromium, Cr	150 - 880	–do–
7. Manganese, Mn	220 - 590	–do–
8. Lithium, Li	Below 20	–do–
9. Arsenic, As	Below 5	–do–
10. Cadmium, Cd	Below 1	–do–

Table 2b
Nature and composition of Ambient – Air SPM near an Industrial Complex

1.	Range of Ambient air SPM	:	36 - 650 ug/m^3
2.	Respirable (PM10) Fraction	:	10 -30%
3.	Volatite Fraction/Loss	:	15 - 45%
4.	Benzene Soluble Fraction	:	8 - 34%
5.	Lead in Ambient - air	:	0.1-2.3 ug/m^3
6.	Vanadium in Ambient - air	:	0.3-5.9 ug/m^3

Table 3
Preliminary Fiding of Rajgangpur Health Survey 9-12, May 1994

Catg. No.	*Category of examined subjects by work history*	*Total No. of subjects examined*	*Percents of examinees in category having respiratory problems*				*Sprio-metr Average PFF PVC*	*Test results Average FEVI/*
			Very severe suspected of or confirmed TB/Silicosis tuberculosis	*Other severe problems*	*Moderate respiratory*	*No. respiratory*		
A.	OCLR-over 15 yrs.	96	31.5%	14.5%	42.5%	11.5%	327	78%
B.	OCLR-8 to 15yrs.	36	22.5%	11.0%	55.5%	11.0%	422	89%
C.	OCLR 8 yrs.	28	7.0%	3.5%	58.0%	31.5%	452	92%
D.	OSM	29	3.5%	3.5%	31.0%	62.0%	536	93%
E.	Other Industries	30	6.5%	33.5%	33.5%	56.5%	486	92%
F.	Offices/Shops	12	8.0%	–	50.0%	42.0%	460	93%
G.	Housewives	27	3.75%	3.75%	37.5%	55.0%	365	91%
H.	Students/Children	24	4.0%	12.5%	25.0%	58.5%	303	98%
		282						

Jayanta Moitra &
Nandita Moitra
Central Pollution Control Board
Parivesh Bhawan
East Arjun Nagar
DELHI - 110 032.

Toxicants in the Environment

1.0 Introduction

Human exposure to environmental hazards is conditioned by the inborn constitution or genetic make-up of the individual and disease is rarely the result of a single factor but rather of a combination of related factors. Data on dust pollution and its health effects, though not plentiful, have increased in the last decade. The pathophysiological effects of exposure to dust are not expected to vary from one part of the globe to another, but the intensity of effects may be more pronounced in the developing countries because of unhygenic living conditions, malnutrition, etc. It would be unrealistic to assume that the threshold limit values derived for the developed countries are applicable to workers and general population in tropical developing countries, who may have a background of under-nutrition and disease and who may be exposed to an unhygenic environment.

2.2 Some reported case studies on dust pollution

A. *Shanghai, China* : It has been noted that male cancer mortality in Shanghai is highest in China and that from 1963 to 1985, lung cancer mortality increased from 0.029% to 0.044%. It has been observed that lung cancer incidence is highest within urban districts and lowest in the outermost suburban areas, and higher in industrial and commercial regions than in the residential areas in Shanghai. In relating lung cancer mortality to dust pollution, it was shown that the concentration of highly carcinogenic compound benzo (a) pyrene was also highest. In one area of Shanghai, where extremely high levels of hexavalent chromium had been measured, it was reported that all children who attended a particular elementary school failed the military entrance physical examination and the people had a high lung cancer rate compared with other communities. The observed levels were associated with chronic pulmonary insufficiency in the aging population and susceptible individuals.

B. *Los Angeles, USA* : Epidemiological studies on chronic bronchitis, asthma, chronic obstructive respiratory disease and definite air obstructive disease show that there has been a significant impact of these diseases on the general health of the population of Los Angeles, resulting in increased health costs for the population and possible reduced life expectancy for the more seriously affected individuals. Recent studies on 6112 adults in six US cities have shown that a strong correlation exists between PM_{10} levels and mortality.

C. *Tokyo, Japan* : In Tokyo, the health effects of dust pollution have been studied scientifically and statistically. According to the law of "compensation for health damages due to dust pollution", the number of people reporting "recognised" dust pollution diseases has been recorded since 1975. However, although the pollution situation in Tokyo generally improved from 1975 to 1988, the number of cases reporting diseases rose from about 6500 to 43,600 in the same time period. Thus in 1988, it was concluded that dust pollution was not the only cause of the diseases and the law was changed accordingly.

D. *London, UK* : Diseases or disorders commonly associated with dust pollution and thought to be aggravated by them in London include chronic bronchitis, pneumonia, lung cancer, emphysema and silicosis. It was estimated that more than 20,000 people die each year from chronic bronchitis in the entire UK. The worst episode of bronchitis mortality was during the "great London smog" on December, 1952, claiming 3000 lives. Death occurred mainly among elderly persons suffering from chest or heart diseases.

E. *Kanpur, India* : It was reported that the workers of preparatory sections of the textile mills, including the softening, bale opening, scouring and carding operations suffer from excessive dust pollution. The hazard in jute mills was maximum, followed by woollen mills. A health survey in the jute mill showed almost all workers of the preparatory sections to be suffering from some or the other respiratory ailment.

F. *Ahmedabad, India* : Antyodaya Foundation has moved to the Gujarat High Court against the State Govt. seeking justice for textile mill workers suffering from byssinosis, first brought to public notice by the National Institute of Occupational Health (NIOH). There is a provision of payment of compensation by the Employees State Insurance Corporation (ESIC) under the Employees State Insurance Scheme (ESIS), to workers certified by NIOH to be suffering from occupational diseases. But the ESIC has overruled the NIOH findings due to inadequate medical evidence on the cause of byssinosis.

G. *Delhi, India* : According to latest estimates, every third citizen in Delhi suffers from some form of respiratory ailments and the number of such individuals is twelve times the national average. Delhi is the third most polluted city after Los Angeles and London, in terms of dust pollution and the largest number of asthmatics in the country reside in Delhi.

H. *Bhilai, India* : Of the total cases reported at the Bhilai Steel Plant Hospital during 1990, as many a 42% were of respiratory ailments, 17% of enteric disorders, 22% of physical injuries and the remaining of other miscellaneous diseases. Due to the presence of a large superphosphate plant in Kumhari near Bhilai, a large number of musculoskeletal disorders of human and animals have come to public notice.

I. *Shillong, India* : The region is pollution-free with about 40% registered cases of enteric disorders in the District Civil Hospital. Information from the Directorate of Health Services, Shillong revealed that most of the people suffers from caries and during the flowering season of pines, hay fever (allergic rhinitis) disease rise drastically due to the allergic nature of air-borne pollens. The region is free from the major source of anthropogenic lead emission and the only source is the odd 500 taxis/buses, which run on leaded gasoline. The incident of cataract is also very rare in Shillong.

Therefore it can be concluded that like many developing countries, the correlation between PM_{10} levels and associated mortality and morbidity were never studied in India. Health damages caused due to dust are hardly known to the majority of people whose knowledge is confined to irritation of eye, skin or throat as possible harm done by dust. Even a generalized planning tool for exposure assessment and design of health-related surveys were not formulated for use in the Indian context.

4.0 Conclusion

1. It is not merely the dust concentration in ambient air that would indicate the human health risk, but the presence of respirable fractions, called PM_{10}, and the composition of PM_{10}. Dust particles in the range of 5-10 microns are trapped in the nasal passage or at the back of the throat and particles less than 5 microns size gets phagocysed in the alveoli of lungs and possess health risk.

2. Health damages caused by dust are hardly known to the majority of people whose knowledge is confined to irritation of eye, skin or throat as possible harm done by dust. There is also a lack of general awareness to dust related diseases among the medical practitioners, who often diagnose the symptoms as tuberculosis, bronchitis or pneumonia.

3. The legal system lacks enough teeth to provide due compensation to the affected workers. Moreover the workers are unorganised and ignorant of the dust-caused diseases and the legal aspects.

4. A few studies conducted on eyes and teeth in polluted and non-polluted area provided more evidence to the fact that specific dust pollution is one of the causative factor for cataract formation and teeth disorders. Cigarette smoking and use of coal based 'chulhas' are prevalent in our country. They are the recognised contributory casual factors in various lung ailments. But the studies could not provide any relationship between dust related diseases and smoking or indoor pollution due to the lack of a generalised planning tool and survey design criteria necessary for such exposure assessments.

5. Therefore the most important task before the scientists of our country is to test whether there is any significant relationship between estimated individual exposures to PM_{10} and the prevalence of respiratory disorders, taking into account the effect of all confounding factors.

6. No exposure limit in terms of fibre length has been prescribed for selected dusts in India. OSHA has established a limit of 2 fibres per cubic centimeter of air for exposure to asbestos dust. There is a lack of diagnostic evidence to the exact cause of byssinosis, fibrosis or silicosis in India. The dust fibre length, its retention in the lungs and translocation or migration effects are never studied. The adverse effects of such dusts on the phagosomal membrane and alveolar macrophages are unknown. The present diagnostic approach to test the pulmonary functions is limited to the use of spirometer and pneumatochometer and determining the Forced Vital Capacity and comparing the results with control values. Electron microscope and X-ray diffraction are essential tools to analyze lung parenchyma, peribronchiolar and perivascular lesions, interstitial or septal scarring etc. and diagnose the disease and its causes. A separate specialised course for the medical personnel should be introduced at the MD level possibly in the department of cardiorespiratory physiology or social and preventive medicine.

7. Even though serious efforts are being made in our country to study the dust related diseases, there is a serious lacunae in the preparation of health economics data. Medical geography has been neglected since long time. A national atlas of disease mortality in India has never been prepared. No attempt has been made to prepare demographic base maps, which indicates distribution of mortality, vis a vis, chronic bronchitis, bronchial cancer, pneumconiosis, infant mortality, stomach cancer, etc. for the presentation of Standardized Mortality Ratio (SMR).

8. Variation of the 'Human Capital Approach' has never been studied for the Indian population. This involves the estimation of monetary value of diseases caused due to dust pollution by calculating the number of restricted activity days or working days lost and expenditure on treating respiratory symptoms. Based on an analysis of exposure patterns, a programme to control 90% of the power plant particulate emissions and disseminate 30 million improved smokeless chulhas, would cost the same as controlling 100% of the power plant emissions, yet would achieve about twice the reduction in exposure and health hazards.

9. Unless the above mentioned efforts are seriously pursued, problems of health awareness, medical expertise and legal provisions of dust related diseases shall remain unsolved. The policy of pollution control at the source rather than exposing populations to health risks could provide some readymade solutions. This could be done through concerted and sincere implementation and enforcement of pollution control policy, providing better ventilation and exhaust systems in the dust generation sites and strictly following the factory rules related to the work procedure.

Pratibha Gupta, D.K. Banerjee, Rani Kaul and V. Ravi Shankar
Dept. of Psychology, University College of Medical Science
G.T.B. Hospital, DELHI-110 095.

Work Place Environment and Lung Functions of Workers

Introduction

Not so long ago, scientists from the West used to organise seminars and symposia to discuss various aspects of "Cosmic dust"[1]. Perhaps that time it was beyond one's imagination that very soon, tons and tons of suspended particulates would be poured every day in our breathing environment.[2,3] This situation is quite serious specially in developing countries where the promise of sustained, relatively rapid and equitable per capita economic growth at the cost of environmental pressure due to rapid urbanisation seems to be an unavoidable concern.[4] And one is painfully aware of the several sources and forms of pollution present in the work place causing an adverse impact on individuals. Though such occupational awareness started as early as the second century AD when miners covered themselves with sacks and used animal bladders as masks to protect themselves from dust, but it was not until the sixteenth century began, that it gathered momentum with observations by Agricola and Paracelsus.[5] The pollutants of work place may be present in the form of gases, vapours, noise, thermal, acidic fumes, organic and inorganic substances, trace elements and other particulate load of various fractional sizes.

Ventilatory function tests (FVC, FEV_1, FEV_1/FVC%. PEF_{25-75} PEFR & PIFR) were carried out in 667 rubber factory workers of East Delhi. These workers were divided into three groups according to their nature of work, and further each group was divided into four subgroups depending on the duration of exposure. Simultaneously work place environment was quantified and chemical analysis was carried out for PAH compounds, nitrates and sulfates of TSP and fractional size of particulate load, collected from there. In the majority, decrement of all the lung functions were observed in compounding section workers (Group III) as compared with others (Group I & II) and this abnormal pattern of lung functions was directly related with increasing duration of exposure to pollutants. For statistical analysis, one way analysis of variance with Tuky's was performed. Test technique using an SPSS package was incorporated. And the relationship between the results of the pulmonary function tests

and variable was assessed by multiple liner regression with an examination of residuals. Channel chosen by pollutants to enter the body is through the respiratory system, as it directly communicates with external environment.[3]

The literature survey does reveal a number of studies carried out abroad, highlighting the adverse effect of these wide variety of industrial pollutants on pulmonary functions of the exposed workers.[6] However, to utilise these results for our workers would not be appropriate as there are distinct ethnic, racial, regional and working pattern differences apart from others. And to fill up this gap the present study was planned in a rubber factory of East Delhi. A few selected lung functions were made in workers belonging to three sections and their correlation with work place environment was worked out.

Materials and methods

Three different sections were identified as packing-loading, vulcanization and compounding and groups were formed accordingly. Group I (n-78) workers were involved in packing loading of the final product (tyres and tubes) in an open country yard. Group II (n-44) workers were engaged in processing the already mixed rubber to give the desired shape and form by exposing to high pressure and temperature and in another subsection rim wire and other accessories were added to tyres and tubes. Workers (n-148) of compounding section formed Group III. Here raw rubber is mixed with hundreds of substances in a furnace.

Sampling of workplace environment

A total of 15 samples for SPM (Suspended Particulate Matter) from each section of 8 hours duration were collected in a three months time by using Kimoto High Volume Sampler on glass fiber filter paper (GF/A Whatman) at a flow rate of 1.7 l/M ^{3}/Min. And for fractional sizes of particulates Five Stage Kimoto Cascade Sampler was operated. Six samples from each unit were collected for 8 hour duration by running high volume sample at 1.7 L/M^3/min on glass fiber filter paper (GF/A Whatman) giving fraction sizes of (in ug):>10.4,>5.2, >1.6, >0.6 and <0.5 respectively. Polynuclear Aromatic Hydrocarbon (PAH) compounds like benzo (a) anthracene, benezo(a)pyrene, and benzo(e) pyrene were extracted in Soxhlet extractor using benzene as a solvent for duration of 8-10 h (8.9). Extracted samples were concentrated in Buchirota vapor and analysed on Ferrand-3-Scanning Spectro-fluorometer. The quantitative determinations were carried out by using excitation-correction instruments. The sulfates and nitrates were estimated turbidometrically and colorimetrically, respectively. The benzo(a)pyrene from five fractions of particles was also determined by the above methods.[8,9]

Lung Function Tests

A standard questionnaire to record details on age, duration of employment, smoking habits and full medical history was completed by all 667 workers. Their height and weight were measured. The lung function comprised of FVC and FEV_1 and flow rates such as Forced Expiratory Flow (FEF) at 25, 50, 75% of FVC (Forced Vital Capacity) Peak Expiratory Flow Rate (PEFR) and Peak Inspiratory Flow Rate (PIFR), were measured by using Electronic Lung Function (ELF), Equipment of P.K. Morgan. It is a portable unit providing a direct comparison between measured and predicted valued in a printed form.[10]

Each group of workers were further subdivided into four subgroups depending upon the duration of work exposure as upto 6 months, 6 months to 3 years, 3 years to 6 years and above 6 years.

Statistical analysis

Data analysis was carried out by one way analysis of variance with Tuky's test technique using an SPSS package. The relationship between the result of the pulmonary function tests and other variables were assessed by multiple linear regression with an examination of residuals. Values are expressed as the mean and standard deviation.

RESULTS

Table 1 shows the highest concentration of SPM and PAH compounds viz. benzo (a) pyrene, benzo(a) anthracene, sulfates and nitrates in compounding unit as compared with other two.

Table 1 : Main Concentration of Rubber Factory Pollutants in three sections of Rubber Factory

Sl.No.	Parameter	Section I	Section II	Section III	F Value
1.	SPM (mg/m^3)	77.32 + 21.36	147.37 + 47.87	155.44 + 12.68	11.16*
2.	Benzo (a) Pyrene (ng/m^3)	0.90 + 0.59	0.74 + 0.49	9.66 + 1.55	202.31*
3.	Benzo (e) Pyrene (ng/m^3)	46.76 + 14.23	128.43 + 94.93	283.62 +104.63	13.75*
4.	Benzo (a) anthrance (ng/m^3)	1.15 + 0.58	1.66 + 1.56	6.83 + 3.07	17.94
5.	Sulphates (mg/m^3)	27.96 + 5.84	23.24 + 3.77	40.96 + 12.13	10.44*
6.	Nitrite (mg/m^3)	6.41 + 2.87	5.23 + 1.65	20.70 + 7.50	26.46*

* 0.001 (ANOVA)

From the analysis of variance a significant difference (P<0.001) could be seen amongst these pollutants from one section to another. The concentration of five fractional size of particulates alongwith their benzo(a) pyrene content are expressed in Table 2. At <0.5 um fraction size there is highest concentration of SPM (6600 ug/m^3) and also of benzo(a)pyrene (10.94 ng/m^3) the SPM to which the packing and loading workers were exposed was significantly less than that to which the other workers were exposed at the two smallest fraction sizes (P<0.01). The concentration of benzo(a) pyrene was seen to decrease with an increase in particle size throughout.

Table 2
The concentration of suspended particulate matter and Benzo (a) pyrne at various size of particulates in packing and loading vulcanisation and compound units.

S.No.	*Particulate Size Um. UM*	*Packing & Loading*		*Unit Vulcanisation*		*Unit Compound Unit*	
		SPM (ng/m^3)	*Benzo (a) pyrene (ng/m^3)*	*SPM (ng/m^3)*	*Benzo (a) pryene (ng/^{3})*	*SPM (ng/m^3)*	*Benzo (a) pyrene (ng/m^3)*
1.	10.4	5.52 + 3.63	0.32 + 0.46	5.46 + 2.46	0.31 + 0.11	5.74 + 0.40	0.1 +0.01
2.	5.2	7.22	0.72	11.02	0.82	11.77	0.71
3.	1.6	9.62 +4.17	1.16 + 0.57	15.11 +3.46	1.16 + 0.51	16.53 +4.59	2.01 +0.97
4.	0.6	10.27 + 3.67	2.01 + 0.59	20.90 +1.98	1.34 +0.34	21.86 +4.59	5.94 +2.10
5.	0.5	38.49 + 12.79	3.65 + 1.70	65.09 + 22.67	5.85 +1.20	65.99 +11.12	10.94 + 2.10
6.	Total SPM	77.32 +21.86		147.37 +47.87			155.44 +12.68

Demography and Symptoms

All workers in majority had income Rs.1,469 to Rs.1,639/per month. Their mean age, height and weight ranges were 23.8 - 27.9 years, 161.1 - 161.7 cm and 50.0 - 51.6 Kg respectively and there was homogeneity between workers in all groups.

Symptoms reflecting respiratory problems were recorded from each worker. It could be seen that percentage of all these symptoms are higher in workers of compounding unit as compared with others. Regarding lung function results of PVC, FEV_1/FVC ration in all three groups, decrease in these values can be observed proportionately as the exposure time of the worker increases from 6 months duration to more than 6 years. The result of various flow rates as of FEF_{25}, FEF_{50}, FEF_{75}, PEFR & PIFR in all the groups, reveal that these results are towards the higher side in group I as compared with others. In majority, a significant reduction in lung functions in workers having work duration of 6 years and more Multiple Regression Analysis was carried out between lung functions (FVC & FEV_1) and concentration of particulars and other parameters including age, height, weight, calorie intake, smoking, working hours/day and employment duration etc. These pulmonary functions are found to be inversely related to the concentration of particulates and benzo (a) pyrene in the work place air. Amongst PAH compounds, benzo(a) pyrene appeared to have significant effect on all these flow rates except on FEF25%. A significant effect of suspended particulate matter was also observed on PIFR values.

DISCUSSION

The present study examined the quantitative and qualitative effect of work place environment on the lung functions of rubber factory workers. The three groups studied consisted of workers who packed and loaded tyres and tubes into transport vehicles and who therefore may be exposed to pollution from the diesel exhaust of transport vehicles[11] and from neighboring industries. In the vulcanisation section, the work consisted of final cutting, moulding, applying rim wires to the tyres and other required parts to the tubes. Finally in the compounding section, the raw ingredients and hundreds of chemicals are heated and milled to obtain softened rubber.

The presence of high concentration of PAH compounds viz.benzo(a) pyrene in SPM as well as in smallest particulate fraction, benzo(e) pyrene, benzo(a) anthracene and sulfates and nitrates in compounding section and is perhaps attributed to the mixing of raw rubber alongwith chemicals (Table 1 & 2). Besides these there is continuous emission of noxious gases such as SO_2 and NO_2 as a part of industrial contribution. Some of these gases get converted in the atmosphere to secondary products like NH_4, SO_4, HSO_4 and H_2SO_4 which then stay in the environment in submicron sizes. These secondary products alongwith PAH compounds may produce simple irritation to carcinogenic changes to respiratory systems[1].

While comparing results of our lung functions such as FVC and FEV_1, saw and rice mill workers[13] show a similar trend as with increasing duration of exposure. There is a decrement

in their results and the above pattern is also supported by a study[14] of 10 year exposed rubber factory workers reporting a significant decrease in FEV_1/FVC valued as compared with the control group. Bachani's Talc workers[15] also exhibit time related decrease in their lung functions.

Comparison of Flow rates (FEF 25.75) of our workers with those exposed to silica dust[16], grain dust[17], vanadium pentoxide[18] and isocynate[19] depicts a decreased pattern of lung functions (flow rates) in these subjects as compared with controls. The duration of exposure plays an important role in further deterioration of these functions. However, an additive effect of smoking was also observed for the present status of these lung function results in them (13-16). Rao et al[20] also noted a hazardous effect of auto exhausts and smoking on shop keepers, showing a decrease in FEF_{25} and stressed on the importance of recording these flow rates (FEF 25-75) since lower results indicate small airway obstruction perhaps due to deposition of inhaled pollutants in due course of time. We do not have enough research reports to compare our results. However, while comparing with medical students of Vellore[21] and Libyan adolescents[22] their results are better than with our industrial workers which is not only attributed to their better height and weight but because they represent a non-industrial population.

In the present study on these rubber workers we also observe the prevalence of various abnormalities of respiratory system specially in group III subjects of the compounding section. Therefore, one may not hesitate to mention that these PAH compounds and particulate load plays havoc on the health profile of these rubber factory workers. By visualising all the hazardous effects more longitudinal or chart studies are recommended.

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References

1. *The New York Academy of Sciences 1963.* Conference on Cosmic Dust.
2. Pollution in Delhi proving fatal : *Times of India. WB.* June 24, 1994.
3. *Frazier CA,* 1980. Occupational Asthma. *Von Nostremed Reinhold Company 102-109.*
4. *Fox,J.1977.* Occupational Mortality. 1970-72. Population trends. *London HM Stationary Office.*

5. *Champman and Hall 1977:* 1977. Occupational Asthma. In Asthma, 202. ***Edited by T.J.H.Clark and S.Godrej. London.***

6. *Corey P, Hutcheon, M.Brodes, I and Mintz, S.*1982. Grain elevator workers show work related pulmonary function changes and dose effect relationship with dust exposure. ***Br.J.Indust. Med.39: 330-337.***

7. *Monarea, S. Pasquini R, Sforsolini GS, Viola V and Fagiolo F.* 1982. Application of the salmonella mutagenicity assay and determination of PAH in work place exposed to petroleum pitch and petroleum coke. ***Int. Arch. Occup. Environ. Health. 49: 223-239.***

8. *Handa, T, Kato Y, Tamamura T, Ishii T and Suda K.* 1980. Correlation between concentration of polyaromatic hydrocarbons and those of particulates in an urban atmosphere. ***Environ. Sci. Technol. 14: 416-422.***

9. *Katz, M, Ghan C.* 1980. Comparative distribution of eight polycyclic aromatic hydrocarbons in air borne particulates collected by conventional high volume sampling and by size fractination. ***Environs Sci Technol 7: 838-843.***

10. *Gupta P and D.K.Banerjee* 1989. Pulmonary function profile in metal factory workers of Delhi. ***Am Natl Acade Med Sci.(India) 25 (3) 255-261.***

11. *Brooks, Al, Li AP, Dutcher JS, Clark, CR, Rotheoberg, SJ, Kiowa R, Bechtold WE and Mclellan RO.* 1984. A comparison for genotoxicity of automative exhaust particles from laboratory and environmental sources. ***Eviron Mutag 6: 651-668.***

12. *Junk GA and Form CS* 1980. A review of organic emissions from selected combustion process. **Chemosphere.** ***9: 157-230.***

13. *Bhat MR, and Ramaswamy CA.* 1991. Comparative study of lung functions in rice-mill and saw mill workers. ***Indian J Physiol Pharmacol 35, 27.***

14. *Governaa M, Comal M, Valentino M, Antoni Celli L, Rindaldi F and Pisani E.* 1987. Ventilatory function in rubber processing workers. Acute changes over the workshift. ***Br. J. Ind. Med. 44: 83-89.***

15. *Bachani D,* 1984. Chronic air flow limitation in talc industry. Role of age, smoking habits and dust exposure. ***Indian J Chest Dis Allied Sci. 26: 220-224.***

16. *Choudat O, Frisch C and Barrat G.* 1990. Occupational exposure to amorphous silica dust and pulmonary function. ***Br. J. Ind. Med. 47 : 763-766.***

17. *Horme SL and Cockcroft DW.* 1989. Ethnic differences in the prevalence of pulmonary air flow obstruction among grain workers, ***Chest 95: 992-996.***

18. *Barry SL, Lee H, and Sandy G.* 1984. Respiratory tract irritation associated with vandium pentoxide exposure during oil to coal conversion of a power plant. ***J. Occup. Med. 26 : 567-570.***

19. *Holness DL, Broder I, Corey PN et al.* 1984. Respiratory variables and exposure effect relationships in isocynate exposed workers. ***J.Occup. Med. 26 : 449-455.***

20. *Rao NM, Patel TS, Raiyani CV et al* 1992. Pulmonary function status of shopkeepers of Ahmedabad exposed to auto exhaust pollutants. ***Indian J.Physiol. Pharmacol 36 : 60-64.***

21. *Walter S and Richard J.* 1991. Lung functions of Indian men and women during late adolescence and early adulthood - a longitudinal study. ***Indian J Physiol Pharmacol 35: 15-20.***

22. *Mukhtal MR, Rao CMM and Morghom LO* 1989. Peak expiratory flow rates in Libyan adolescents. ***India J Physiol Pharmacol 223-227.***

Dr H N Saiyed
Eastern Regional Centre
National Institute of
Occupational Health
Calcutta

Dust Related Occupational and Environmental Health Problems in India

Introduction

Among all the contaminants of the atmospheric air, dust is probably the most abundant and ubiquitous. In the work environment in industries, inhalation is by far the commonest route of entry for most of the hazardous substances. Lungs, by virtue of their large surface area (about 70 sq.metres) and direct contact with atmospheric air, are naturally the first to bear the onslaught of air borne contaminants. 'Dust is generally defined as solid particles, organic or mineral in origin and dispersed in air' (Oarkes,1982). Dust can be classified into two broad groups, namely, soluble and insoluble. Soluble dusts like lead, manganese etc., are absorbed by the lungs and are therefore capable of producing systemic poisoning. Exposure to insoluble dusts on the other hand produces local effects on the respiratory system. The insoluble dusts are further divided into mineral and organic dusts. The commonly confronted dusts of organic origin are cotton, flax, hemp, sisal, jute, hay, bagasse, fungal spores,grain dust etc. Byssinosis, acute and chronic extrinsic allergic alveolitis, grain dust allergy, farmer's lung etc. are the examples of the diseases caused by organic dust inhalation. The most commonly encountered dusts of mineral origin in industrial situations are silica, coal and asbestos. The inventory of dusts met in the industrial locations is very extensive and it is not possible to make even superficial remarks about all of them. The commonest dusts encountered in the industrial situations are those of mineral origin. The most widely studied, and acknowledged consequence of long term mineral dust inhalation is pneumoconiosis.

Silicosis

Silicosis is the commonest of all occupational diseases and claims larger number of lives than any other occupational disease (Buechner and Ansari,1969) and even today, it continues to be among the most serious occupational diseases (Hughes et al,1982). On occurrence of silicosis in developing nations in general and in USA in particular, Craighead et al (1988)

commented, "today, in developing and newly industrialized countries, heavy occupational exposures to non-fibrous mineral dusts, occur, resulting in debilitating lung disease. Despite rigid occupational health standards and considerable publicity, pneumoconiosis continues to be a problem in our modern industrialized societies." The presence of subclinical lesions in the lungs of industrial workers at autopsy are a mute testimony documenting subtle, but consequential, exposures to mineral dusts today. (Craighead and Vallayathan,1980).

The distribution of silicon in nature is similar to that of carbon in organic matter and it is next only to oxygen in abundance. The earth's crust is composed almost entirely of silica and silicates. Silicon occurs as silicon dioxide (SiO_2) which is known as free silica, and in the form of silicates it is known as combined silica. Free silica occurs in crystalline and amorphous forms. The crystalline free silica is one of the most powerful fibrogenic substances found in nature. About 12% of earth's crust consist of crystalline free silica, mostly quartz (Willey, 1971; Ronov and Yerovesky, 1969). In the earth's crust free silica is next only to feldspar in abundance. (Zaidi,1969)

Occupational Exposure to Free Silica and Population at Risk

As seen earlier, the earth's crust contains a large amount of free silica and therefore, mining and tunneling are in necessity occupations most closely related to the hazards of silica. The sand stone industry, cement industry, quarrying, the granite industry, slate quarrying and dressing, grinding of metals, iron and steel foundries, silica milling, flint crushing, the manufacture of abrasive soaps and glass also involves occupations which are important from the hazard point of view and peculiar to India and some other developing nations. Table 1 shows the number of people employed in various industries in India with the potential risk of exposure to free silica. It is seen from the table that there are about 1.7 million workers engaged in mining of various minerals, iron and steel industries, cement industry, manufacturing of glass, foundries, quarries etc. All these industries involve potential risk of exposure to siliceous dust and subsequent development of silicosis.

Recognition of Silicosis in India

Silicosis is as old as human civilization; however, its recognition as a disease entity was realized only in the seventeenth century (Hunter,1978). Mining and metallurgy in India were practiced much earlier than in Europe, but the first cases of silicosis in this country were described in the 1920s among the gold miners in Kolar. In gold miners of Kolar, the disease was more conspicuous by its benign nature in sharp contrast to its counterpart in gold miners of South Africa and Australia. Fibrogenicity, the most important biological characteristic of

Table 1 : Average employment* in the industries in India having potential risk of free silica exposure	
Industry	*Employment*
Structural clay products	222,000
Manufacturing of glass and glass products	67,000
Cement,lime and plaster	78,000
Mica products	12,000
Iron and Steel industries	208,000
Foundries	284,000
Agate industry **	10,000
Slate pencil industry **	8,000
Coal mines	550,000
Copper ore mines	13,000
Chromite mines	9,000
Gold mines	12,000
Gypsum mines	1,000
Iron ore	49,000
Lime stone mines	51,000
Magnesite mines	6,000
Manganese ore mines	18,000
Mica mines	3,000
Stone mines	11,000
Other mines	77,000
Total	**1,691,000**

Source : *Handbook of Labor Statistics, 1991, Labor Bureau,Govt. of India. **Estimated on the basis of studies carried out by the author.

free silica dust, was found lacking in the siliceous dust of Kolar gold fields. These findings created great interest and excitement amongst the scientists the world over. Even a hypothesis was put forward postulating that the fibrosis of lungs observed in the miners was caused by sericite, a fibrous mineral, usually present in the rocks along with quartz (Jones,1933). The theory was soon refuted. Nevertheless, this added to an already existing impression that the problem of silicosis in India was not of serious nature.

In 1936, when the ratification of the International Labour Organisation (ILO) Convention concerning Workmen's Compensation was discussed, the then British rulers, in the absence of evidence of the incidence of this disease, did not include it in the list of compensable diseases. The Royal Commission on Indian Labour (1929-30) found no evidence of incidence

of occupational diseases including silicosis. However, Dr.V.R.Khanolkar in a memorandum submitted to the Labour Investigating Committee stated that " the health authorities ignore the existence of silicosis in their published report and it is probable that many deaths resulting from it lie in the unsorted block of respiratory diseases, which occupy an imposing place in the Indian Vital Statistics". The Report did not put on record the fact that "it is possible that these occupational diseases do not exist but it is equally possible that they are not diagnosed". However, it was recommended in the Report that, "there is a strong prima facie case for arranging for a periodical medical examination of miners by experts and also for equipping hospitals with such medical and surgical equipment as would make the diagnosis of such cases easier" (Quoted by Gupta,1970).

In 1934, an X-ray plant was installed in Kolar gold mines. However, the first large scale survey was delayed till the introduction of the Mysore Silicosis Rules in 1940. In 1947, Caplan, who is better known for his description of rheumatoid pneumoconiosis (Caplan's syndrome), was first to publish a comprehensive report on silicosis in Kolar gold mines (Caplan and Burdon, 1947). The sense of greater social obligation of the government towards the working community in the post-independence era proved that the facts related to pneumoconiosis in general and silicosis in particular were contrary to what the British Government had concluded. The first industrial hygiene division in India was established in 1949 by the Chief Advisor of Factories under the auspices of the Ministry of Labour. The objective of establishing this division was to study the occurrence of occupational diseases and environmental hazards in factories and mines. Silicosis was made a "Notifiable Disease" under the Factories Act 1948 and the Mines Act 1952. This notification served as a stimulus for the study of silicosis in various industries and mines. A large number of study reports on the subject are now available from various sources.

Shenoy (1980) presented a review of 330 autopsies done at Kolar gold fields between 1939 and 1980. On the basis of his study he defined Kolar pneumoconiosis as "non-collagenous pneumoconiosis". The findings of this study confirmed the earlier report by Caplan. Gowda (1983) found radiological evidence of silicosis in 820 (13.9%) out of 5893 gold miners examined between 1973 and 1978. Rangacharyulu (1987) compared the pulmonary function tests of 279 underground gold miners (Kolar gold fields) according to the radiological severity of silicosis. He found no correlation between the radiological severity of silicosis and PFT. He attributed his failure to demonstrate the correlation to smaller sample size.

The radiological examination of 369 mica processing workers revealed evidence of pneumoconiosis of category 1 or more in 23 (6.23%) workers and evidence of pleural thickening was found in 16 (4.3%) workers (NIOH 1982). Gangopadhyay et al (1993) in

a study of 119 female mica processing workers reported 2.7% prevalence of pneumconiosis. They also reported high prevalence of pulmonary function abnormalities in these workers which corresponded with the dust concentrations in the work environment. In another report the same authors reported 5.26% prevalence of pneumoconiosis from a study of 463 mica processing workers from Bihar. They also reported high prevalence of lung function abnormalities in these workers compared to non-exposed controls (Gangopadhyay et al 1994).

Studies in other mines :

Shaw and Deshmukh (1993) on analysis of 100 cases of pneumoconiosis (50 each from refractories and copper mines) found that 21 (42%) of the copper miners suffering from pneumoconiosis were asymptomatic but all pneumoconiotic subjects from refractories had respiratory symptoms. They also observed that 65 (65%) out of 100 pneumoconiotics were treated for tuberculosis.

Sethi and Kapoor (1982) in a study in 72 stone cutting workers found 18 (25%) cases of silicosis. Rane (1982) in a study of environmental hygiene and pulmonary function tests in workers exposed to free silica dust in refractory industry, found that out of 84 workers, 50 (59.6%) showed pulmonary function abnormalities. The mean dust levels in the grinding department was 119 (25-440) mppcf with 75% free silica. Clerk et al (1982) on radiological survey of 342 agate workers found evidence of silicosis in 63 (18.4%) subjects. One of the sufferers was a child aged 11 years only. 3.8% of the workers had conglomerate silicosis. The environmental survey showed that the mean dust concentrations during agate grinding was 209.3 (20.0-877.0) mg/M3. About 90% of the dust was respirable. Analysis of agate and emery dust showed 82.8% and 62.2% free silica respectively. Saini et al (1984) in a study of radiological study of 60 stone cutters in Kashmir found evidence of silicosis in 12 (20%) workers. Rastogi et al (1988) found no statistically significant differences between the pulmonary functions of female agate grinders with and without pneumoconiosis. Samal et al (1986) in study of 195 non mechanized iron foundry workers found evidence of pneumoconiosis in 53 (27.2%) and tuberculosis in 19 (9.7%) workers. They also observed higher prevalence of tuberculosis amongst the subjects having radiological evidence of pneumoconiosis. Srivastava et al (1988) in an epidemiological study of 373 glass bangle workers found radiological signs of pneumoconiosis in 27 (7.3%) workers. The mean dust levels was 12.65 mg/M3 with no free silica. In the absence of evidence of free silica exposure they concluded that the pneumoconiosis observed in this workers was possibly caused by exposure to dusts and fumes containing different metals in the work environment.

Silicosis in Slate Pencil Workers

The problem of silicosis in slate pencil workers of Mandsaur (M.P) was brought to the light by Jain et al (1977). Subsequently, NIOH undertook more detailed environmental and epidemiological studies with the objectives of defining magnitude of the dust related morbidity and recommending suitable preventive measures. The environmental and medical study of 593 slate pencil workers showed that 324 (54.6%) workers had category 1/1 or higher degree of silicosis. 105 (17.7%) workers showed evidence of progressive massive fibrosis (PMF). The 'total' and "respirable" dust concentrations during the cutting process were 46.47 (11.03 - 177.0) mg/M^3 and 10.41 (4.27-18.39) mg/M^3 respectively and the mean free silica contents of the dust was 56.5% (Saiyed et al 1983). Follow up examination of 279 of these workers after an interval of 16 months showed that out of 127 subjects whose x-rays were normal in the previous survey 23 (18.1%) developed simple silicosis and 14 other subjects developed PMF. 23 (3.9%) of the subjects who had participated in the initial survey died during the intervening period. Their mean age at the time of death was 43.7 (18-55) years and the mean duration of work was 11.75 (3-20) years. All the deceased subjects were male and were suffering from PMF (Saiyed et al 1985;Saiyed and Chatterjee 1985). The immunological studies showed increase in the levels of lgG and lgM in the workers having silicosis (Karnik et al 1990). The pulmonary function tests showed high prevalence of obstructive type of abnormality which was attributed to exposure to high levels of dust The Pulmonary Functions Test abnormalities were seen even in workers with normal chest radiographs (Mohan Rao et al 1991). Young workers between the 15 and 18 years of age showed significant decrease in FEF (Mohan Rao et al, 1992). As a result of intervention program recommended by NIOH to the Ministry of Labour, Government of Madhya Pradesh, an exhaust system with air cleaning device was prepared specially for the slate pencil industry and installed on 10 cutting machines. The industrial hygiene survey showed that the exhaust system was effective in controlling about 90-95% dust and the residual dust levels were very close to the TLV (Saiyed,1986; Ghodasara et al 1992). At present most of the factories of Mandsuar District use one or other form of local exhaust systems. These local exhausts however, are not always fully effective in controlling dust and the lack of incorporation of air cleaning device causes the problem of air pollution.

Study of silicosis in agate workers

Following a newspaper report, a writ petition was filed in the Hon. Gujarat High Court, alleging that a large number of agate workers of Khambhat (Gujarat) were dying of silicosis. Hon. Gujarat High Court constituted a three member committee, consisting of the author (as expert on occupational diseases), a senior lawyer of the High Court and a Deputy Chief

Inspector of Factories. On the request of the Committee, the author and his colleagues of NIOH carried out a fact finding scientific study. The medical survey of 470 agate workers showed that the problem of silicosis was limited to the agate grinders only. The prevalence of silicosis in male and female agate grinders was 39.8% and 34.2% respectively. Pulmonary function abnormalities were found in 50.8% male and 51.3% female grinders.

The mean "total" and "respirable" dust concentrations during agate grinding (horizontal emery wheel) were 25.4 (14.5 - 35.1) and 2.74 (1.73-4.04) mg/M^3 respectively. The free silica contents of the dust was 60%. For the control of dust, NIOH scientists with the help of a local agency developed a local exhaust system containing an air cleaning device. Subsequent evaluation of the exhaust system by dust monitoring showed that it was highly effective and the dust levels could be brought down below TLV. The exhaust system did not interfere with the work. On the contrary it facilitated the work by removing the dust which interfered with working. At present many small units have installed this type of exhaust system (NIOH, 1988, Saiyed et al, 1987).

Silicosis in quartz crushing workers : The study of 75 quartz crushing workers revealed evidence of silicosis in 9 (12%) workers. More than 90% of these workers had been exposed for less than 3 years. Three cases of silicosis were observed in workers exposed for less than 1 year. The mean respirable dust concentrations in six factories ranged from 1.9 mg/M3 to 24.3 mg/M3 with 95% to 99% free silica. In this survey sources of dust generation were identified and appropriate dust control measures like the enclosure of dust source, use of powerful exhausts, humidification of work environment etc. were suggested. After implementation of these control measures, the industrial hygiene survey showed that there was 80 - 96% reduction in dust levels (NIOH,1986).

Silicosis in stone quarry workers : Radiological examination of 127 stone quarry workers revealed the evidence of silicosis in 28 (22.0%) workers. The mean respirable dust concentrations in two quarries were 0.80 and 0.85 mg/M^3 respectively with about 70% free silica (NIOH,1987). The scientists of the Institute developed a simple dust hood covered by a plastic shield as its roof and cloth on its side walls. With the use of this dust hood more than 50% respirable dust could be controlled.

Silicosis in sand grinding workers : At the request of the Chief Inspector of Factories, Gujarat State, 36 (9 male and 27 female) ex-grinding workers who have been exposed to very high concentrations of almost 100% quartz were examined. Radiological evidence of silicosis was present in 10 (27.8%) subjects. Of these, 3 (8.3%) had simple silicosis and 7 (19.4%) had PMF. The average age of silicotics was 28.2 years and their mean duration of exposure was 6.3 years. The environmental hygiene study could not be undertaken in these factories as

all of them were forced to close. The analysis of raw material showed that it contained 85-95% free silica. Immunological studies in 19 of these subjects showed that 4 (21.0%) were antinuclear factor (ANF) positive and 5 (26.3%) were positive for-reactive proteins (CRP), (NIOH, 1989; Nigam et al,1990).

Coal Workers' Pneumoconiosis in India

The finding of old smithy furnaces and slag heaps close to the coal deposit regions in Eastern India indicate that coal was used in metallurgical processing even as early as two thousand years ago. Systematic coal mining in India began in 1774. By the mid-nineteenth century, coal mining was well established and coal production was about 90,000 tones per year. Despite the long history of coal mining in India, the first cases of coal workers' pneumoconiosis were reported as late as 1956 by Dr.K.B.Roy from Nowrozabad Colliery in Madhya Pradesh (Roy,1956). Out of five cases of pneumoconiosis reported by him, four were complicated pneumoconiosis. Damodaran (1960) came across 30 cases of pneumoconiosis during 8 years of his service at Central Hospital, Dhanbad. One case of pneumoconiosis, he observed, had just 3 years of exposure. He also found some association between pneumoconiosis and rheumatoid arthritis.

Patnaik and Parihar (1990) on analysis of 144 cases of pneumoconiosis diagnosed on periodical medical examination in South Eastern Coal Fields (SECL) found that 137 (95%) cases showed small opacities on x-ray and only 7 (5%) cases showed large opacities. Three subjects having pneumoconiosis had exposure for less than 10 years. Srivastava et al (1991) reported a prevalence of 1.85% pneumoconiosis on the basis of periodical medical examination of 20,086 coal miners. On analysis of 374 pneumoconiosis cases, discovered during periodical medical examination, they found that 95% of the cases were simple pneumoconiosis and only 5% cases were those of progressive massive fibrosis (PMF).

Regional Occupational Health Centre (ICMR), Calcutta has been identified by ICMR as the advanced centre for the studies in dust related diseases in the Eastern region. The Centre carried out comprehensive environmental studies in seven underground coal mines and epidemiological study of 5,777 underground coal miners. The results of the environmental study revealed that the coal dust levels were higher than prescribed TLV in all the underground mines included in the study. The free silica contents (analysis by IR spectrophotometry) of respirable dust were about 1%. The prevalence of simple pneumoconiosis (category 1/1 and more) and PMF was 2.84% and 0.05% respectively. The majority of the cases of pneumoconiosis belonged to category 1/1. Comparison of prevalence of pneumoconiosis in different mine areas indicated that the collieries having higher rank coal

(coal with high fixed carbon contents, low volatile matter and low ash content) had higher prevalence of pneumoconiosis. The most striking feature of the study was high prevalence (about 45.3%) of lung functional abnormalities. The most frequent PFT abnormality was obstructive in nature (Report ROHC(E), 1993).

The centre also carried out similar study in four surface coal mines employing about 2000 workers of both sexes (Report ROHC(E), 1994). 1589 (1236 men and 353 women) surface coal miners participated in the study. The environmental study showed that the mean coal dust levels and its free silica contents were higher than TLV. The prevalences of chronic respiratory symptoms in male and female workers were 17.0% and 16.4% respectively. The chest radiograph of 26 (2.1%) male and 9 (2.5%) female surface coal miners showed pneumoconiosis of category 1/1 and more. No cases of PMF were found. The overall prevalence of obstructive (including mixed) functional abnormality was 24.1% and 20.2% in male and female surface coal miners respectively.

Non-Occupational Pneumoconiosis

Until recently it was believed that the problem of silicosis and other types of pneumoconiosis was limited to industry only, although a few scattered case reports describing non-occupational pneumoconiosis cases are available (Goyal,1958, Sepke 1961, Farina et al. 1968). However, Dr. T. Norboo, a chest physician, working at SNM hospital, Leh (Ladakh), came across cases of respiratory morbidity who did not respond to routine treatment and whose radiological picture resembled pneumoconiosis (Norboo et al 1991). The problem was studied in more detail by the author and his colleagues (Saiyed et al, 1991; Saiyed et al 1992; Saiyed 1994). There are no industries or mines in any part of Ladakh and therefore exposure to dust from these sources is ruled out. Two factors considered responsible for the development of this strange respiratory morbidity were : (1) Exposure to dust from "dust storms". In spring, dust storms occur in many parts of Ladakh. During these storms the affected villages are covered by a thick blanket of fine dust, and inhabitants are exposed to considerable amount of dust for several days. The frequency, duration and severity of these dust storms vary considerably from village to village. (2) Exposure to soot- due to severe cold as the ventilation in the houses is kept at a minimum. The same fire place is used for cooking and heating purposes. To conserve fuels during non-cooking periods, the wood is not allowed to burn quickly but is kept smoldering to prolong its slow heating effect. The dwellers are thus exposed to high concentration of soot. The clinico-radiological investigations of 449 randomly selected villagers from three villages having mild, moderate and severe dust storms showed prevalence of 2.0%, 20.1% and 45.3% respectively. The chest radiographs of the villagers showed radiological characteristics which were indistinguishable

from those found in miners and industrial workers suffering from pneumoconiosis. The dust concentrations in the kitchens without chimneys varied from 3.22 to 11.30 mg/M^3 with a mean value of 7.50 mg/M^3. Dust samples sufficient to allow measurement of the dust concentrations could not be collected during the periods of dust storms, but preliminary analysis of the samples indicated that about 80% of the dust was respirable and its free silica contents ranged between 60% and 70%. Detailed statistical analysis of data showed that the frequency of dust storms, use of chimney in the houses and age were the most important factors related to the development of pneumoconiosis (Venkaiah et al,1993).

Prevention and Control of Pneumoconiosis

Country wide pneumoconiosis control should consist of two major components:

1. Definition of magnitude of pneumoconiosis problem at national level and
2. Implementation of actual dust control measures.

Definition of magnitude of the Problem at National Level : To plan and execute the national strategy for the prevention of pneumoconiosis, the knowledge of the total population at risk and number of people already affected is very essential. The population at risk of pneumoconiosis can be roughly estimated on the basis of available information on industries, their location, raw material, industrial process and employment in each of them. This should be followed by comprehensive industrial hygiene and epidemiological surveys in the sample population. After estimation of population at risk of pneumoconiosis and identification of more vulnerable groups, the industrial and medical surveys should be carried out. The industrial hygiene survey shall include measurement of "total" and "respirable" dust at work places and the qualitative analysis of dust samples. The tools of epidemiological survey are recording of occupational history, clinical history and physical examination, chest radiograph and spirometry. Chest radiography is the most important single investigation having a high degree of specificity but relatively low sensitivity. The history and physical examinations help in excluding other respiratory diseases. The spirometry may help in appraisal of the functional loss. The results of the sample surveys will help in identifying the thrust areas. The thrust areas may be defined on the basis of number of people at risk and the severity of hazards. Industries having moderate risk but employing smaller number of workers e.g. slate pencil industry, agate industry, quartz grinding industry etc., fall in this category. For the reasons already mentioned, there is a special need for looking into the problems of small scale and cottage industries.

Implementation of Actual Control Measures : The process of the control of pneumoconiosis consists of, (1) dust control measures and (2) medical measures.

Dust control measures : There is no pneumoconiosis, without dust exposure, and the dust levels in work environment correlates well with incidence of pneumoconiosis. Therefore, elimination or suppression of dust in the work environment is the key in control of pneumoconiosis. Each industry has its unique work process and therefore it is not possible to have a single prescription appropriate to all. The general principles of dust control measures include substitution of more hazardous substances with the innocuous ones of the isolation and enclosure of the sources of dust, use of wet methods wherever possible, application of local and general exhaust, humidification of work environment etc. Recently a new equipment has been developed for predicting the dustiness of material (Cowherd et al, 1989). The use of such equipment may help in the selection of less hazardous material.

Frequently, the management is found to share the misconception of laymen that the supply of dust masks is sufficient for the prevention of dust related occupational diseases in the industry. The personal protective equipments such as masks should be prescribed only when all available methods of dust control measures have failed. In fact, dust masks are of little value when the dust concentrations are too high, for the dust particles will soon clog the pores in the filter resulting in a choking sensation and discontinuance of the use of masks by workers. Moreover, the masks are not suited for a hot and humid climate.

Medical Surveillance : As per the recommendation of WHO (WHO, 1990), the medical screening programme should be integrated and pursued with the environmental surveillance programmes so that the results of both could be related to reviews of measures taken to control the environment. The medical examination is necessary because perfect knowledge does not exist as to the safe level of exposure. Medical surveillance should be continued, not as a control method, but to verify the adequacy of dust control measures. The medical measures for the control of pneumoconiosis include pre-employment and periodical examinations, incorporating chest x-ray and spirometry. The employment medical examination will provide the baseline data for each individual. The periodical medical examinations shall aim at early detection of cases of pneumoconiosis. In recent years, some newer diagnostic methods have been introduced for the early detection of pneumoconiosis. Computerized topography (CT) is superior to plain x-ray. By this method, it is possible to detect small lesions due to pneumoconiosis which would be otherwise invisible on plain x-ray (Nakajima, 1988). The newly designed ultrathin broncho-fiberscope is another technique which may help in early detection of pneumoconiosis (Tanaka 1988; Tanaka and Hahimoto,1990). These diagnostic methods are expensive and they should be used only in special cases.

Summary and Conclusions :

The health problems caused by occupational and environmental dusts are widespread in

India. Exact data on the incidence of pneumoconiosis are not available for most of the industries. However, on the basis of the epidemiological studies carried out in the country, one may conclude that the situation is alarming, particularly in some of the cottage and small scale industries like slate pencil cutting, stone cutting, agate industry, quartz grinding, stone quarrying, and mica mines. This list is definitely not complete and probably represents the tip of the iceberg. There must be many more industries with similar or even worse conditions. For the complete assessment of the situation, the need for comprehensive epidemiological surveys cannot be over emphasized. The recent reports on occurrence of non-occupational pneumoconiosis on almost epidemic scale on some villages of Western Himalayan should be a cause of apprehension for all concerned.

There is no pneumoconiosis without dust and therefore, elimination or suppression of air borne dust is the key in the control of pneumoconiosis. Extensive epidemiological and industrial hygiene surveys should be the basis for identifying the thrust areas. On the basis of these surveys dust control technology may be developed catering to the specific need of each industry. For dust control measures to be successful, they should be simple, economical and acceptable to the workers. For an effective dust control program, efforts are needed from research workers, law enforcing authorities and the owners of the factories. The medical control programme should be integrated and pursued with the environmental surveillance programmes so that the results of both could be related to reviews of measures taken to control the environment. There is need for closer liaison between law enforcing authorities, entrepreneurs, workers and research personnel. The ultimate success in any preventive program will depend upon the cooperation of the workers. The need for the health education of the workers therefore cannot be over emphasized.

Gnanamani A. and
Kasturi Bai R.

Epidemiology of Air Pollution

Introduction

On an average we breathe 14 to 18 kg of air in a day while we consume only 1.5 to 2.0 kg of water in one form or another and no more than 0.7 kg of dry solid matter as food. Man cannot survive for more than a few minutes without air whereas he can be kept alive for days without food. The insensible, intimate interpenetration of air, which courses in and out of the lungs, gives to air pollution its essential importance. Air is essential to the senses of sight, smell, and hearing, and its pollution assaults the first two of these.

Toxic environmental factors may be found in the food and water human consume as well as the air humans breathe, and in materials contacting the skin.

Though we have long insisted on the need for uncontaminated drinking water and food, it is only in recent years that we seriously began to recognise the importance of clean air to health.

The systematic study of naturally occurring association between health effects and pollution has been called the "epidemiology of air pollution". Whether or not the association between pollutant exposure and possible effect is thought to be casual, will depend both on the variety, specificity, and strength or associations shown by epidemiological studies, as well as their concordance with experimental studies in animals or man.

The effects of air pollution on personal or community health are :

(a) acute sickness,

(b) insidious or chronic disease,

(c) alteration of important physiological functions,

(d) impairment of performance,

(e) storage of potentially harmful materials in the body,

(g) discomfort, odour, impairment of visibility.

There are at least three routes by which industrial substances can gain entry into the worker's body. In order of importance they are inhalation, skin contact, and ingestion.

The pollutants may be classified according to their physical and chemical properties. They may be gaseous, e.g. NOx and SO_2; or solid, e.g.; soot, dust and sodium aluminium fluorides. Some may have reducing capacity, e.g., sulphur dioxide, while others have oxidising capacity, e.g., ozone; some may be acidic, e.g., hydrogen, hydrogen fluoride, while others are alkaline, e.g., cement dusts.

Some of the highly industrial gases and vapors of low solubility can produce an immediate irritation and inflammation of the respiratory tract and pulmonary oedema. Prolonged or continued exposure to these gases and vapors may lead to chronic inflammatory or neoplastic changes or to fibrosis of the lung. Fibrosis, as well as granulomatosis and malignancy, also may be produced by certain insoluble and relatively inert fibrous and nonfibrous solid particulates found in industry. Indeed, it is now thought that one of the prerequisites for particulate-induced bronchogenic carcinoma may be the insolubility of the particulate in the fluids and tissues of the respiratory tract, which thereby allows requisite residence time in the lung for tumor induction.

Domestic Pollution

Home heating and cooking are capable of generating a group of air pollutants (carbon monoxide, sulfur oxides, oxides of nitrogen, sooty and oily aerosols) whose health effects have commonly been overlooked. During periods of low winds and still weather, the dissipation of such domestic pollution will be impaired to a similar extent as the dissipation of outdoor air pollution.

In general, oxidants are about half as concentrated within buildings in polluted areas as they are outside, but carbon monoxide and nitric oxide are likely to occur at similar concentrations indoors and out, since they are influenced neither by the walls of rooms or by air conditioners and filters. If smoking or cooking occurs indoors, exposure to carbon monoxide and nitrogen oxides may be quite high.

Effects of Gaseous Pollutants

The reaction of nitric oxide with hydrocarbon vapors in the presence of sunlight leads to production of ozone and nitrogen dioxide in the atmosphere, alongwith many other compounds. The experience of human atmosphere with oxidant air pollution is likely to be variable, because among other reasons, the photochemical mixture is composed of

different constituents at different times and at different locations. The human "symptoms" of photochemicals among, respiratory and eye irritation, were first observed in the Los Angeles, California Basin. The "diagnosis" can be confirmed because of the presence of the three other manifestations-production of ozone, interference with visibility and characteristic forms of vegetation damage.

Carbon monoxide and lead are examples of pollutants whose effects depend on the quantity in the body, and this, in turn depends on a balance between uptake and excretion. Both are also pollutants for which substantial exposures to the public occur from sources other than air pollution. Carbon monoxide is not irritating. Experimental carbon monoxide studies usually expose man or animals to square wave doses, that is, with an abrupt increase above or decrease to background, which permits a smooth prediction of resulting carboxy haemoglobin. The amount of carbon monoxide carried by the haemoglobin is used as an estimate for how much carbon monoxide is in the body. Nearly all the carbon monoxide in the haemoglobin is excreted unchanged, via the lungs, with the expired air. It is relatively easy to determine the amount of carbon of the expired air after holding breath.

Nitrogen Dioxide and Other Nitrogen Oxides

Of the seven oxides of nitrogen known to exist in the ambient air, only two are thought to affect human health. These are nitric oxide, NO and nitrogen dioxide, NO_2. At the present time there are no data either from animal or human studies showing that nitric oxide at the levels encountered in the ambient air is a health hazard. Nitric oxide is readily oxidized to nitrogen dioxide. This oxidation may occur in the atmosphere or in the membranes and tissues lining the airways.

Both nitric oxide and nitrogen dioxide, if transferred across the lung-blood barrier, can produce inactive forms of haemoglobin, the most important of which is called methemoglobin.

In vitro, nitric oxide is so closely bound to haemoglobin that it will readily replace carbon monoxide; however the lack of observation of a human nitric oxide-haemoglobin complex in vivo implies that the combination occurs only under conditions in which oxygen is nearly absent. While some questions remain about haemoglobin reaction with oxides of nitrogen, there is no positive evidence that nitric oxide exposure is a health hazard associated with community air pollution.

NO_2 is found as a pollutant in association with certain types of rocket fuel and is known to cause occupational disease. Nitrogen dioxide effects tend to occur many hours after

exposure has ceased. Persons occupationaly exposed are often unaware of the severity of their exposure.

Among occupations with NO_2 hazards are the manufacture of nitric acid, exposure of farmers to silage that has high nitrate fertilization, electric arc welding, and mining utilizing nitrogen compounds as explosives. In the manufacture of nitric acid, exposures estimated at 30-35 parts per million of nitrogen dioxide did not appear to show effects of injury.

It is estimated that eye and nasal irritation will be observed after exposure to about 15 ppm of nitrogen dioxide and pulmonary discomfort after brief exposures to 25 ppm. It is likely that pathological changes can be detected on the basis of exposures of 25-75 ppm for short time periods. It is also thought that exposure to 150-200 ppm of nitrogen will lead to gradual production of fatal pulmonary fibrosis.

Some of the hydrocarbon vapors in the atmosphere have health implications. Among the aldehydes of importance are formaldehyde and aerolein, both potent irritants.

Benzene was a popularly used solvent, but its industrial use is now restricted because sufficient exposure to it interferes with the formation of red blood cells in the bone marrow. Leukemia occurs in some individuals with long-term occupational exposure.

Particulate Pollutants and their effects

Asbestos : The occupational hazards of asbestos were first recognised in 1924. Observed reactions were primarily the deposition of asbestos in the lung with production of fibrotic reactions and stiffening of the lung, resulting in shortness of breath. The awareness that asbestos exposure is likely to cause increased cancer frequency datas from 1949.

Lead : The major source of exposure to lead is from food and water, with estimated intake of 0.12-0.35 mg/day. From 5% to 10% of ingested lead in adults may be metabolically absorbed, whereas from 20% to 50% of the lead inhaled from community air pollution may be metabolically absorbed into the body. The percentage absorbed tends to be higher with smaller particle sizes. Acute forms of toxicity are manifested when blood levels in adult males are greater than 75 mg/100 gm. Three types of toxicity are documented-gastrointestinal cramps (lead colic), central and peripheral nervous system effects (lead encephalitis, wrist drop), and anemia. Kidney disease, excess frequency of hypertension, and vascular disease have been reported but are not universally accepted as long-term effects.

Cadmium : The cadmium emitted from industrial and domestic sources will be inhaled by

human or animals or will be deposited in soil, vegetation, or water. Irrigation with cadmium-contaminated water and the use of cadmium-containing fertilizers and sludge from sewage treatment plants can build up cadmium levels in soil so that uptake of cadmium in the growing plant will be increased. Wheat and rice have been shown to absorb significant amounts of cadmium. Cadmium in paints and plastics may sooner or later end up in incinerators whose effluent may become airborne. Cadmium has been measured at up to 1% in children's plastic toys, but the risk for children who might chew on the toys is small, since the cadmium seems to be firmly bound to the plastic.

The normal concentration of cadmium in air is about 0.001 mg/m^3 and will not contribute significantly to the daily intake of cadmium. Cadmium concentrations in air around cadmium-emitting factories, however, may be several hundred times greater.

Mercury : Mercury occurs in the environment in several physical and chemical forms. The most obvious distinction is between the inorganic forms and the organomercurials. The term "inorganic" refers to elemental mercury vapor, mercurous and mercuric salts, and complexes in which mercuric ions can form reversible bonds to tissue ligands, e.g. thiol groups on proteins. "Organic mercury compounds" are those in which mercury is linked directly to a carbon atom by a covalent bond. The organic mercury compounds are further subdivided into the alkyl, aryl, and alkoxyalhyl groups. There is a great variation in toxicity, especially among organic forms. Two of the alkyls, methyl and ethyl-mercury, an aryl form, is less toxic and could be compared to some of the inorganic forms in this respect. Phenylmercury, like inorganic forms, is converted to mercuric ion in the animal or human body, whereas the alkyls are not.

Trivalent chromium low toxicity is the form in which chromium most often occurs naturally. Hexavalent chromium has high toxicity, and its presence is usually associated with industrial activities. Both forms can occur in air. Occupational exposure to hexavalent chromium compounds, which are both irritant and corrosive, has caused symptoms in both the respiratory tract and the skin. Nasal perforation has been a common finding in workers exposed to chromates. It is also well established that lung cancer may result from occupational exposure to chromates.

Manganese : Manganese is considered as an essential element for man and other animals, which means that some manganese is critical to normal biochemistry and physiology.

Manganese has been shown to be a useful additive to fuel oil for reducing particulate emissions. It also has some desirable antiknock properties as a gasoline additive as methyl cyclopentadenyl manganese tricarbonyl (MMT). Although no community air pollution

problems from manganese are now known, if its use as a fuel additive should increase, to as much as 0.5-2.0 gm of manganese per gallon of gasoline, the amounts in the air will surely increase. The possibility of such a problem should be evaluated before such additives are widely used.

Particulate pollution

Smoke emitting from the combustion of the major fuels comprises particles of soot, fine dust and ash in a mixture of gases. Other dust and ash may be blown into the air from sources such as ash heaps, coal dumps, cement factories and smelters of non-ferrous metals, but these are less important as sources of particulate pollutants in the air than the combustion of fuels. While dispersed in the air, such particles may affect plant growth by reducing the intensity of light and its quality; this effect is limited to the vicinity of towns or industrial sites. After deposition, particulate pollutants may be injurious to plants and animals in various ways but again they are unlikely to cause problems to any considerable distance from the point of origin. As solid particles are frequently deposited in areas where gaseous pollutants are present their effects may be modified and difficult to isolate.

Our knowledge is quite deficient on what levels of hazardous compounds are safe for the public and the industrial worker. In fact, new chemical agents are manufactured even before the existing ones are fully evaluated. Bacterial cultures to detect mutagens are widely used. Human beings, in fact, all animals and plants, often detoxify or adapt to ambient concentrations of such agents. On the other hand, many of these agents may have unrecognized effects, at least in some people. They may lower one's susceptibility to viral and bacterial agents or contribute to the onset of cancers appearing many years after exposure. Living in an industrialised society we must accept some of these liabilities along with the multitude of assets that our society provides to enhance the comforts and variety in life.

There are a number of variables other than air pollution that condition the health effects of urbanization. These include (a) demographic factors, (b) meteorological and climatic factors, (c) occupational exposures (including unemployment), (d) use of household fuel for cooking and heating, (g) income and education variables. (b) spread and occurrence of infectious disease, (i) nutrition, and (j) smoking. Demographic factors include ethnic origin, age, family structure, and migration history. Household crowding and dilapidation are often interrelated with low income, education status, recent urban migration, and the spread of infectious disease.

P A Subramanian
Asst. General Manager
(Maint. Service)
Salem Steel Plant
Salem - 636 013
Tamil Nadu

Steel Manufacturing Industry

Introduction

Factory managements do their best to hush up asbestosis cases. "For instance, of the 240 workers at an asbestos packing and manufacturing company in Maharashtra, 40 suffer from asbestosis - and 16 have allegedly died of it - with their lung function disability varying from 10% to 75%. Although such cases had allegedly been detected by factory medical inspectors in the past, the reports had been shelved. Workers revealed that 20 of the victims opted for voluntary retirement, while six have been sacked. No action has ever been taken against the company.

Asbestosis has peculiar symptoms: a crackling sound while breathing and "finger clubbing", a thickening around the base of the nails. Asbestosis has a deadly twin brother: because the membranes of the lungs and abdomen are lined with the fibre, a victim can contract mesothelioma, an incurable and fatal cancer. Blue asbestos is 10 times more hazardous than white in this respect and some experts claim that after an exposure of just five minutes, a person can contract mesothelioma even 20 years later. Families of workers are also vulnerable because fibres stick to their clothes and they carry the menace home. US Government health officials estimated in 1978 that in the US alone 50,000 new cancer cases would occur annually for 30 more years as a result of past exposure to asbestos.

British journal "New Scientist" in February 1981 wrote "The road to Shri Digvijay Plant was lined on both sides by asbestos cement waste. A high wall surrounded the factory. Outside... untreated waste water emptied into a trench piled with solid asbestos on either side". "Solid waste littered the neighborhood where houses stand... children played on the wastes around their houses". The Central Labour Institute studied this factory and reported that 7% of the 320 workers were suffering from asbestosis.

Pneumoconiosis

This is the most common disease associated with coal mining industry - it is also called "Black

Lung". It is endemic in coal mines. Workers who are long exposed to coal dust are not only rendered incapable of hardwork but can also succumb to it. According to Dr. J.L Kaw "Dust predisposes a person to tuberculosis. It hastens the course of the otherwise latent disease. The patient dies sooner or later due to heart failure or tuberculosis".

A random study by Central Mines Research Station, Dhanbad, had revealed that 8% of miners suffer from pneumoconiosis. According to Dr. P.K. Dutta, former President of Indian Medical Association, about six out of every ten miners are physically unfit to undertake "hazardous and back-breaking jobs" partly because of their exposure to dust.

According to a sample survey by Dr. J.K. Sinha, Dy. Director of Central Mining Research Station, Dhanbad, "of a group of 150 workers studied, 10% had an advanced form of the disease; a few collapsed later". If a worker works six hours a day drilling stone, he dies in just five years" he pointed out. If you take a man away from the job, he may survive but he will no longer be able to work.

Case Study, Salem Steel Plant

Salem Steel Plant is located in Tamil Nadu at a distance of about 300 km from Madras. It is designed to produce about 70,000 tons of stainless steel sheets and coils starting from hot rolled bands either obtained indigenously or from imported sources. Housekeeping and Environment Management are top priorities of plant operation. Salem Steel is known for the quality of products and it was the first steel plant in India to obtain ISO 9002 certification. On the environment management front, Salem Steel Plant won the Paryavaran Puraskar awarded by SAIL for special steel plants for the past two years in succession. Regarding dust pollution in Salem Steel Plant, the areas of concern are the coal fired boiler and the shot blasting equipment. A mechanical dust collector has been installed in the boiler and a bag filter has been provided in the shot blasting machine to collect the dust emanating from the above equipment. These have been functioning very satisfactorily. Stack monitoring and ambient air monitoring are being conducted regularly to monitor various parameters like particulate matter, sulphur dioxide, oxides of nitrogen and carbon monoxide. All the parameters are found to be well within the norms prescribed by Tamil Nadu Pollution Control Board.

Innovation

Ash handling in the boiler area was posing several problems. While one problem was to physically collect the ash from different locations in the boiler such as front end hopper, ridding hoppers, grit interceptors, economiser and dust collectors, the other was to manually

carry it to the ash collection yard. The work did not end there. Ash from the yard had to be transported to a further dump a few kilometers away from the boiler house. Besides, this form of disposal had many disadvantages:

- While the dry ash had to be quenched with water before dispensing by dampers and pay loaders, it could not be done before collection and manual handling, as wet ash would be considerably heavy
- the fine fly ash was causing pollution in boiler plant and its surroundings
- the fine dust was a health hazard to those exposed
- the hot ash from hoppers was hazardous

The answer was the mechanised ash handing system that would be relatively simple and trouble-free. But it cost the earth to set up one; standard manufacturers quoted anywhere between Rs. 15/-, Rs. 16/- lakhs for the job. Salemites took up the challenge. They would design, manufacture, erect and commission a mechanised ash handling system with minimum bought out items. And they did so in 20 days flat – a record by any standards. The way this task was accomplished is an object lesson in ingenuity and resourcefulness.

As the types of ash produced varied in size - very fine fly ash from dust collector, fine ash from economiser and grit interceptors and lump ash, clinkers from the front and riddling hoppers – a specific method of disposal for each type of ash that is to be collected from different locations was to be devised.

The fly ash separated from the flue gases in the dust collector was made to pass through an automatic discharge flap valve so that the ash flow is continuous. In a novel and simple method, this fly ash was mixed with water to form a slurry and then solid ash particles were separated from water in a settling pit designed for the purpose. The waste water coming out of coal feeders and spreaders after cooling the bearings were utilised for mixing. No fresh water was therefore required for disposal.

The ash collection points of grit interceptors and economiser were joined together so that collection was at one place without dispersal. Again, using the waste cooling water, a slurry disposal system was designed; a suitable automatic discharge flap valve was fabricated and fixed in the common ash collection line and a slurry mixing tank with continuous ash and water flow was erected.

A quench tank covering all front end hoppers and riddling hoppers was designed in such a way that the ash, which is relatively bigger in size and discharged at high temperature,

is quenched immediately and is carried by a conveyer system having an endless belt partially immersed in water. By the time the ash comes out of the water surface on the conveyer, it is completely quenched and this wet ash is discharged into a damper or titling type trailer parked under the discharge end, the process continuing.

The entire fabrication and machining works of components involved were completely carried out in the mechanical repair shop attached to the plant. The only item which was bought from outside was the idler rollers.

The new system has been working satisfactorily ever since it was commissioned in the year 1988. The design is flexible enough to allow any future modifications and further improvements as and when thought of. The total cost of the system was a mere Rs. 50000/-. But the advantages it offers are manifold. The significant benefit is in the area of pollution control and elimination of health hazards.

Conclusion

1. While industrialization is necessary for the development of a country, it is necessary to ensure that it does not have an adverse impact on the environment.
2. Dust generated from industries can lead to diseases of the lung which may prove fatal or result in permanent disablement.
3. By installation of appropriate pollution control equipments like electrostatic precipitations, bag filters etc. discharge of dust can be controlled.
4. Workers can be protected by providing them with respirators.
5. By innovative methods such as adopting wet processes dust generation can be reduced.
6. It is necessary to continuously monitor the stacks and ambient air to ensure clean air.
7. Air that we breathe is vital to all living beings – let us keep it clean.

Kapil Kumar Sharma
Technical Assistant
Jalandhar, Punjab

Spinning and Dyeing Industry

Introduction

Now as the world is stepping towards 21st century with scientific research and technology at its peak, "dust" one of the major air pollutants causing a serious threat to occupational and environmental health. Occupational health relates with the working conditions and the dust components in those conditions. Environmental health can be related to community health, IE atmospheric dust, which affects the total community. India is also one of the sufferers of the same.

Causes

The main cause of dust can be classified as follows :

i) Improper and uncontrolled industrial growth

ii) Use of low grade technology in industry

iii) Population explosion

iv) Deforestation etc

Sources

The source of dust can be usually classified into the following types :

i) Industrial

ii) Natural

ii) Domestic

i) Industrial Sources

Industry is one of the major sources of dust. Industrial dusts can be classified on the basis

of their formation.

a) ***Combustion*** :

  i) Thermal Power Plants

  ii) Iron foundaries

  iii) Blast furnances

  iv) Open fire (for disposing waste)

The main component of this type of dust contains solid particles, such as, oil droplets etc.

In thermal power plants, the burning of coal, in industries like dyeing industry where rice husk is burnt.

b) ***Material handling***

  1) *Cement Industry*: In cement industry, the finding of lime, gravel, sand etc.

  2) *Food processing*: Winnowing, processing and grinding cause formation of dust.

  3) *Transportation industry*: Transportation industry has also a role in dust formation

    1. By loading and unloading of material like sand etc.

    2. By the movement of cargo or courier which causes loosening of soil and hence forms dust.

  The dust formed from these sources mainly consists of solid particles and smoke.

c) ***Earth moving***

This consists of mining industry, construction industry and agricultural industry.

The dusts which contain solid particles with ash, smoke and chemicals etc.

ii). Natural Sources

Natural sources of dust can be classified into two forms :

i) Sand and dust storms

ii) Volcanic eruptions

The dust from these sources consist of solid and liquid particles of both small and large size. This type of problem mainly arises in desert and loose soil areas.

iii) Domestic Sources

Domestic sources of dust mainly result from

a) cleaning

b) dusting

c) combustion of fuels etc.

Case Study – I

Industry : **Spinning and Dyeing Industry**

This study in the spinning industry is based on my personal experience as I worked in it for a long time.

The spinning industries consist of mainly three departments:

i) Spinning department

ii) Dyeing department

iii) Post spinning department

In the spinning department, the raw cotton is converted into yarn. The amount of fly and dust is very high in this department. The main cause of this can be attributed to high temperature and humid conditions in the department.

About (8 to 12) gms of dust daily passes into the lungs and a fair amount in the digestive system of a person staying at the machines for 8 to 10 hours daily.

The dyeing department does not produce dust directly but the chemical dust is there. It releases smoke and dust particles in the atmosphere by burning of husk etc. for boiling water.

The post spinning department, which consists of very light dust of flying particles also affects the health. An experiment is conducted on a plant which is kept outside the spinning department where there is an exhaust. The plant wilts within a few days due to the thick layer of dust framed on its leaves and later the plant dies off.

So, this dust causes serious occupational and environmental health problems (in the context of the spinning industry). The workers usually suffer from serious respiratory disorders and skin diseases.

The surrounding plant and animal population is also seriously affected.

The same case can be viewed for other industries like the chemical industry.

Now-a-days there is a threat to environmental health e.g. even milk contains certain chemical substances and their quantity is very high in the animals staying near these industries.

The main reason for this is low graded and obsolete technologies used in the industry.

Case Study – II

(Amount of suspended particles in atmosphere in three major cities of Punjab i.e. Ludhiana, Jalandhar, Amritsar).

Now in this case study we will discuss the amount of suspended particles in the atmosphere in the context of environmental health. The data is given below :

Data-I

1. Date - 22.11.93 to 28.11.93 Season - Winter
   allowed limit of suspended particles = 200 micro gm/m^3

City	*amount of suspended particles (unit s - microgram/m^3)*
Ludhiana	1116 microgram/m^3
Jalandhar	816 microgram/m^3
Amritsar	817 microgram/m^3

Data - II

Date 28.2.94 to 6.3.94 Season - Spring

Ludhiana	744 microgram/m^3
Jalandhar	610 microgram/m^1
Amritsar	572 microgram/m^3

The data given above shows the amount of suspended particles and its variation. This large amount of suspended particles causes a number of environmental health problems.

The case for Ludhiana specially which is an industrial city of Punjab gives the clear picture about the role of industry in dust formation. The case for other industrial cities is almost the same.

Effects on atmosphere

Reaction of Solid Particles

i) Solid Particles take part in a number of reactions. In these reactions solid particles

  a) Catalyse the reaction e.g. The decomposition of ozone is catalysed by solid surfaces;

  b) Particles absorb and destroy free radicals;

  c) The absorption of gases on solid surface changes the spectrum for sunlight e.g. the absorption of oxygen on solid surface causes absorption of sunlight.

Poor visibility

The absorption of light by solid particles and its reflection causes poor visibility. The formation of smog is also a dust problem.

Effects on human health

1) Dust has created a serious threat to human health. Dust causes a number of respiratory disorders like silicosis, asbestosis, T.B., lung functioning and their impairment, poisoning by metallic dust.

2) Historical point of view:-

  i) The Meuse valley of Belgium was covered by dust and smog for five days causing the death of sixty three persons and about one thousand became ill.

  ii) London smog (5.9.1952) which remained for 5 days and caused 4000 deaths.

  iii. London smog in 1956 caused 1000 deaths.

  iv. Dust is now a days becoming a serious threat to human health.

Effects on plant life

The plants are also the one of the main surfaces of this so called dust pollution.

1. *Layer formation* : The dust and fly ash etc. form a layer on the surface of leaves which in turn causes the death of a plant.
2. *Poisoning of plants*: Important plants, some of which are susceptible to poisoning by heavy metal dust.

Conclusion

From above discussion, it is very clear that "dust", produced by any source affects the occupational and environmental health. So, we have to control it by all means. Otherwise it will have a devastating effect on the next generation, directly or indirectly.

Dr Uday Raj Singh
Environmental Planner and Coordinator
Government of M.P.U.T.
Pariyavan Parishar
E-5, Arera Colony
BHOPAL-462 016 (M.P.)

Air Pollution : A vital environmental problem with global concern

Introduction

The world has witnessed unprecedented industrial growth and urbanization during the post-war period. This has resulted in the emission of air pollutants which have become unmanageable both in quantity and quality. The cumulative impact of air pollutants are leading to global climatic change beside poisoning the air. The anthropogenic addition of greenhouse gases, mainly CO_2 has been a matter of prime concern throughout the world, because this will lead to global warming, posing the greatest ecological threat ever to face humanity. It is apprehended that planetary hot-house can result in millions of environmental refugees and loss of biodiversity. Showing concern UNEP Executive Director Dr. M.K. Tolba (UNEP News letter - Asia-Pacific 8:3, 1991) has said "While more scientific effort is needed to clarify the impact of global warming, and the nature of the biological resources being lost, the cause of these potential catastrophes is already too clear. It is the action of the few who have too much, the tragedy of the many who have almost nothing."

Recognizing the importance of the problem the United Nations Framework Convention on climatic change was finalized in May 1992 after 15 months negotiations. By mid-October 1992, 158 countries had signed this convention opened for signature at the U.N. Conference on Environment and Development – the Earth Summit in Rio de Janeiro, Brazil on 4 June 1992. "Ambient air quality trends in major cities indicate that levels of suspended particulate matter are higher than the prescribed standards or limits, especially in the summer months. Levels of nitrogen dioxide are increasing in urban centres with growing vehicle emissions". (National Policy Statement for Pollution Abatement – 1992, Para 2.2). The above policy statement of the government of India endorses the national concern for the problem. The causes of problems of air pollution are release of large quantities of gaseous and particulate pollutants from a large number of sources. At places the emissions are large enough to exceed the assimilative capacity of the air. The result is that more than 3,900 cities/towns/urban growth centres with more than 1 lakh population have begun experiencing the stress of air pollution.

The air man breathes is polluted due to the presence of suspended particulate matter (SPM), oxides of sulphur and nitrogen, carbon monoxide (CO), photo-chemical oxidants and volatile hydrocarbons. These pollutants, individually and collectively, have teratogenic, carcinogenic or mutagenic effects and also cause respiratory ailments; physiological barriers are ineffective against them.

In a number of urban centres in India, industrial units are located in densely populated zones. Industrial complexes are located close to residential areas without considering the consequences of air pollution. SO_2, oxides of nitrogen, hydrocarbons, carbon monoxide and SPM have been identified as some of the major pollutants in such regions. Emissions from industrial units have damaging effects, compounded by automobile emissions.

The National Environmental Engineering Research Institute (NEERI), Nagpur initiated air quality monitoring studies of major cities in India in 1978 to assess the status. The study indicated varying degree of increase in the levels of pollutants in all the places the study was conducted. This study also revealed a correlation between increased NOx level and higher automobile pollution.

Studies conducted in different industrial and urban centres also revealed that the level of air pollution are peaking up. The level of pollution in places like Korba could be comparable to most polluted regions in India. The present pollution status of other regions of M.P. and the experience gained from the studies done elsewhere suggest the need for taking mitigative measures expeditiously.

Population and Pollution

Though the population control measures have resulted in decreasing the number of children born per woman, the number of women of "child bearing age" have increased more rapidly. This has been the main cause for the rapid population growth, specially in developing countries. Such a growing population have enormous impact on the need for housing, water, food, transport, clothing etc. and on the natural resources needed to process them. This will have multidimensional impact on environment, e.g.;

(1) Withdrawal of natural resources, specially the primary producers will reduce the air regeneration capacity of the atmosphere.

(2) The processing of natural resources into goods is bound to add emissions generated from fossil fuel burning.

(3) The bi-products and transportation, and other related activities will also have substantial stress on the environment.

The world population, as per United Nations projections will increase by 3.2 billion between 1992-2025. Out of this growth, 3 billion will occur in the developing regions of Africa, Asia and Latin America. The ratio of percentage share between more developed and less developed regions will be 16:84 by 2025 while it was 33:67 by 1950. Thus the percentage contribution of less developed regions has constantly been increasing from 70% in 1950, 73% in 1965, 76.4% in 1967 and 79.8% (projected by 2000). In contrast, the more developed regions had 33% in 1950, 27% in 1975 and 23.6% in 1967, input in the world population.

Industrial development in India vis-a-vis atmospheric pollution

In relation to developing countries, India's contribution in the world industrial production has been quite impressive. The percentage contribution of south and south east Asia mainly India and Thailand during the decade 1975-1985 was recorded to be highest.

According to the Brundland Commission's report on environment and development, "Our Common Future" – (United Nations 1987), the world industrial production has recorded 400% increase since 1950. As against this four fold increase in world industrial production Indian figures for a similar period, i.e., post independence, are even more impressive. Between 1951 and 1984 there has been ten fold increase in cement production and about eleven fold increase in iron ore production. This has accelerated the pace of construction activities contributing indirectly to urbanization and these urban centres are becoming pockets of air pollution. Electricity production has increased twenty five times opening enormous avenues for industrial development, but has also contributed substantially to air pollution from thermal power plants. To support 300% post independence increase in agricultural production, the production of nitrogenous fertilizer and phosphatic fertilizer has increased 390 folds and 110 folds respectively. Both these fertilizer factories are highly air polluting. There has also been a swift change in the living style evidenced by 60 fold increase in rayon-yarn as against only 2 fold increase in cotton cloth production. Such a swift transition from natural to synthetic/man made things is bound to have its impact on atmospheric pollution. Thus it is now high time to review the situation of atmospheric pollution vis-a-vis industrialisation in the country. The studies conducted by NEERI-Nagpur in the major cities of India have indicated a varied degree of increase in levels of ambient air pollutant in all the places of study. In the forthcoming pages the status of ambient air pollution in some representative industrial and urban areas is being described with the view to project the sample scenario. The studies conducted by NEERI have revealed a correlation between increased NOx level and higher automobile pollution.

Status of Ambient Air Pollution in some representative industrial and urban areas :

Air pollution is a comparatively new subject which has gained momentum in India only after the enactment of Air (prevention and control of pollution) Act 1981. Because of this reason the records of ambient air quality are not available for each and every place of the country, but the records are available mainly for urban and industrial areas. Since air pollution in India is pocketized in these urban and industrial areas, the status of ambient air quality in some representative industrial/urban areas is being discussed here as a sample scenario. Out of four areas included in the discussion, one is mainly an urban centre (Indore) supported with industries within and around it. The second, mainly the industrial zone and urbanization adjoining the main industry (Bhilai Steel Plant, Bhilai) has been induced by industrialisation. Rest of the two areas are exclusively industrial zones for mixed type of foot-loose units (Mandideep) and single type of resource-based units (Mainhar-Jhukehi).

The record of continuous air monitoring of Indore city for three area-categories; (i) mixed use and industrial (ii) residential and rural (iii) sensitive, is analysed. It is indeed a matter of concern that the level of suspended particulate matter in the air was beyond the permissible limit in 8 out of 12 sampling stations. The industrial zone (Kila-Maidan) has recorded a SPM level more than 100% higher than the permissible limit. The busiest commercial centres like Shashtri Bridge and Rajwada recorded the second highest level of SPM-almost 1.5 to 1.75 times more than the permissible limit. Besides the emission from industries, automobile emission in the congested township is mainly responsible for recording higher air pollution than the permissible limit in more than 67% area. This can be treated as a representative sample of a traditional Indian city where industry, township and commercial centre were almost mixed. Bhilai is the another example of a planned industrial town with a higher level of industrial output as compared to earlier ones. The records of ambient air quality around Bhilai Steel Plant project that the SPM level was higher than the limit in more than 58% sampling stations. But it was not as high as Indore. It is notable in this case that the impact of pollutants from major industrial complex like BSP is visible even in nearby villages (Utai-village)-SPM 502, Dundera village-SPM 677, Joharataria village – SPM 819.

The ambient air quality records of Mandideep industrial area do not project any value beyond the permissible limit. This might be attributed to the fact that this industrial area is almost free from highly air polluting industries and has also very low stress of automobile emission due to a very small township. The demand of township development in this industrial area is diverted towards a well developed town (Bhopal) due to its close proximity. This is contrast to an organised industrial area like Mandideep having foot loose industries, the Maihar-Jhukehi is an unorganised industrial zone of resource based industries.

A number of clusters of lime-kilns are operational in this zone because of the availability of lime stone. It is obvious that the levels of SPM and sulphur dioxide around the lime-kilns are far beyond the permissible limits. The simple reasons for this are :

1. Lime-kilns are devoid of any pollution control system.
2. The handling of processed lime further adds to the level of SPM.
3. The burning of coal without any stack in the kiln contributes a lot to increase the SO_2 level close to ground level with a meager scope of wide range dispersal.
4. The adverse meteorological condition for example during the mornings and evenings during winter further deteriorate ambient air quality.

Having analysed these four scenarios it can be concluded that -

1. The status of ambient air quality doesn't depend merely on the number of industries located in the area.
2. Automobiles have a major role in ambient air quality deterioration.
3. Organised industrialisation but with higher industrial output with a proper control system has a lower contribution to air pollution as compared to unorganised industrialisation.
4. The level of air pollution in a planned industrial city having large industries is lower than air pollution in a traditional city with small industries.
5. It is easier to control air pollution at source in a planned industrial city and organised industrial complexes than in unorganised industrial complexes and traditional cities with a number of diffused sources of air pollution.

Comparative role of industrial, domestic and transportation sectors in air pollution

The main contributors in anthropogenic air pollution are the transportation sector, the industrial sector and the domestic sector. The percentage contribution of these three sources in total emission during two decades (1970-71 to 1990-91) of the three mega cities – Calcutta, Bombay and Delhi show that there has been a downward trend in the percentage contribution of industrial sector in total emission in the case of Bombay (68% in 1971; 65% in 1981, 54% in 1991 and 48% projected in 2001) and Delhi (55% in 1971; 40% in 1981; 29% in 1991 and 20% projected in 2001) while it was almost

stable in the case of Calcutta. Though this was the peak period of industrialisation the reduction in air emission may directly be attributed to adoption of comparatively cleaner technology during the recent past. Similarly, the percentage contribution of the domestic sector has recorded decreasing trends in all the three mega cities. There has been drastic reduction in domestic pollution in Calcutta and Delhi where the percentage contribution of domestic sector in total emission has gone down from 27% in 1971 to 8% in 1991 in case of Calcutta and from 21% to 8% in the case of Delhi. The LPG (Liquid Petroleum Gas) has played a major role in reducing domestic air pollution in at least major towns. It is evidenced by the fact that the domestic pollution in Bombay was less than one third of Calcutta and Delhi in 1971 because the LPG was more popular in Bombay due to availability in close proximity. With the increasing popularity of LPG, domestic pollution in Calcutta and Delhi are now only about 8% of total emission as compared to 4% in Bombay. But at the national level domestic pollution was 30% of the total emission in 1985 because of the simple reason that the rural and semi-urban areas are still dependent on fire wood, coal, cow-dung etc.

ii) The level of SPM in the source emission and ambient air recorded in two thermal power plants with adequate and inadequate pollution control technology revealed that the level of SPM in ambient air is within the permissible limit in the case of adequate control technology while it is much above the limit in the case of inadequate control technology. The same is the case for source emission.

Trans-Boundary Air Pollution

Recognising the fact that pollution recognizes no national boundaries, the convention in 1979 on Longrange-Transboundary Air Pollution, was widely publicized. This convention aimed at reducing SO_2 emission.

Strategies to meet the Challenges of Atmospheric Pollution

The problem of atmospheric pollution is global in nature because it leads to global warming by green house gases and ozone layer depletion as discussed earlier. The major contributors to atmospheric pollution are carbon dioxide, methane, ozone, nitrous oxide, chloroflouro-carbon etc. The sources of these gases are direct or indirect energy generation, deforestation, agriculture and industry. It is therefore, essential to understand about the contributors in global warming and their share thereof.

The data provided in the above table give clear indication that the energy and industrial sectors contributing about 73% in total global warming call for the highest priority in

policy planning and strategies to curb the atmospheric pollution. CO_2 having 50% contribution, obviously, becomes the first focus and the energy sector has 70% share in total CO_2 emission. Thus, a strategy earlier indicated to be taken on priority basis will help in meeting the major part of challenge of global warming. With 20% contributions in global warming by CFC, coming 100% from industrial sector and ultimately damaging the ozone layer, the contemporary scenario needs long-term policy planning.

In fact, there may be three types of strategies to address atmospheric pollution :

1. Preventive strategies to reduce quantities of emission.

2. Mitigative strategies.

3. Adaptation strategies to help communities and nation adapt to changes and the consequences.

Preventive Strategies: The policies need to be planned focusing upon the following five key elements :

a) Higher efficiency in energy production and in a wide range of energy uses is the fastest and most cost effective method for reducing emission of CO_2 and other greenhouse gases.

b) Switching from carbon-intensive fuels such as coal to hydrogen-intensive fuels like natural gas. This should be done wherever possible because coal produces nearly twice as much CO_2 per unit of energy as natural gas and 1.5 times as much as oil.

c) Encourage the rapid development of carbon free energy sources such as hydroelectric energy, wind energy, solar energy, thermal energy, photovoltic and nuclear energy. However, biogas energy produced in a renewable manner counter balances the generation of CO_2 by its absorption in photosynthesis.

d) Modifying industrial practices to reduce CFC emission and developing the means to recapture those now in use.

e) Reducing the rate of deforestation.

Mitigative Strategy : Mitigation mechanisms strategies can attempt to compensate for emissions that do occur. Uptake of CO_2 from the air by plants is one of the basic principles of this type of strategy. Thus increasing reforestation might be quite a useful option because more forests might sweep the atmosphere clean of CO_2 – but an area larger than France would have to be planted every year to compensate for current rates of fossil fuel burning.

Adaptation Strategy : It takes only about a decade to develop and introduce a new crop variety. This indicates that agriculture is continuously adapting to climatic variation which is quite slow, providing ample time for adaptation.

Better control of micro-climate inside the building is an example of adaptation by people.

The examples of adaptation to the condition of sea level rise due to temperature increase induced by polluting/green house gases are already available. The Dutch have been living 5 meters below the sea level since centuries. Bangladesh has already adapted to perennial flood which is expected due to sea level rise.

International Efforts : The following sequence of events underline the international efforts to meet the challenges of atmospheric pollution :

1. The pertinent provisions of the Declaration of the United Nation Conference on the Human Environment, adopted at Stockholm on June 16, 1972.
2. Vienna Convention for the Protection of Ozone Layer 1985.
3. The Montreal Protocol on Substances that Deplete the Ozone Layer-1987
4. United National General Assembly Resolution 43/53-1988 recognising climate change as a common concern of humanity.
5. Constitution of Inter-Governmental Panel on Climate Change (IPCC) to investigate the potential severity and impact of global climate change and to suggest possible policy responses - 1988.
6. UN General Assembly Resolution 44/228 of 22nd December 1989 on the UN Conference on Environment and Development (UNCED).
7. UN General Assembly Resolution 44/206 of 22nd December, 1989 on the possible adverse effects of sea level rise on island and coastal areas, particularly low lying coastal areas.
8. First assessment report of IPCC on global climate change published in August 1990.
9. Setting up the Inter-Governmental Negotiating Committee for a Framework Convention on Climate Change (INC) in Dec.1990 to be supported by UNEP and WMO. Negotiations began in February 1991 and ran parallel to the work of the committee preparing for the 'Earth Summit' in the hope that a convention would be ready for signing by the governments in Brazil.

10. UN Framework Convention on Climate Change was finalized in May 1992 after 15 months negotiation.

11. Convention was opened for signature at UN Conference on Environment and Development (UNCED) - the Earth Summit - in Rio-de-Janeiro, Brazil on 4 June, 1992 and 158 countries had signed the convention by mid Oct. 1992.

Roles/Limitation of Developing & Developed Countries

The Earth Summit, through its Convention on climate change, has acknowledged that the anthropogenic addition of green house gases has caused substantial change in the 'Earth's Climate' and its adverse effects are a common concern of the human race.

Underlining the role and limitations of developed and developing countries, the Convention clearly noted that :

- the largest share of historical and current global emissions of greenhouse gases had originated in developed countries, per capita emission in developing countries are still relatively low and the share of global emissions originating in developing countries will grow to meet their social and development needs;
- developing countries whose economies are particularly dependent on fossil production, use and exportation have special difficulties in taking action on limiting greenhouse gas emission;
- developing countries with fragile mountains ecosystems are particularly vulnerable to the adverse effects of climatic change;
- developed countries need to take immediate action in a flexible manner on the basis of clear priorities, as a first step towards comprehensive response strategies at global, national and where agreed, regional levels that take into account all greenhouse gases, with due consideration of their relative contribution to the enhancement of the green house effect;
- all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that, in order for developing countries to progress towards that goal, their energy consumption will need to grow taking into account the possibilities for achieving greater energy efficiency and for controlling green house gas emission in general, including, through the application of new technologies on terms which make such an application economically and socially beneficial.

Indian Policies and Strategies for Abatement of Atmospheric Pollution

India played a vital role in 'Earth Summit' and United Nations Framework Convention on Climate Change. Indian interest in global environmental conservation can be assessed from the fact that our prime ministers had personally participated in both the U N Conferences on Environment held at Stockholm in 1972 on Human Environment and in Rio-de-Janeiro, Brazil in 1992 on Environment and Development.

Beside being a partner in international efforts, India has adopted Pollution Abatement Policy on 26th February, 1992. The basic objective of this policy statement for Abatement of Pollution are to integrate environmental considerations into the decision making at all levels. To achieve this, steps are proposed to be taken to :

- Prevent pollution at source;
- Ensure that the polluter pays for pollution and control arrangement;
- Encourage, develop and apply the best available practicable technical solutions; focus attention on heavily polluted areas;
- Involve the public in decision making.

The Pollution Abatement Policy includes commitments for :

i) Identification of critically polluted areas and evolve mechanisms to reduce local concentration of pollutants;

ii) Providing assistance for adoption of clean technologies by small scale industries;

iii) Revising the present standards based on concentration of pollutants in emission to mass based standards, which will set specific limits to encourage the minimization of waste, promote recycling and reuse of materials as well as conservation of natural resources;

iv) Providing fiscal incentives to stimulate advancement of abatement technologies;

v) Integration of different government departments and agencies, at policy level, responsible for control of pollution;

vi) Introducing Environmental Audit;

vii) Developing a system for collection of authoritative data and use resource account to give an idea how economic policies are affecting the environment;

viii) Ensuring public partnership by creating awareness at all levels through education about environmental risks, the economic and health dangers of resource degradation and the real cost of natural resources.

The 'National Conservation Strategy and Policy Statement on Environment and Development' issued by Government of India in June 1992 also emphasis is on the prevention and control of atmospheric pollution under the head 'Priorities and Strategies for Action, Conservation of Natural Resources - Atmosphere'. The thrust will be on the following :

- Use of clean fuels and clean technologies, energy efficient devices and air and noise pollution control systems;
- Setting up of source specific and area-wise air quality standards and time bound plans to prevent or control pollution;
- Proper location of projects to minimise the adverse impact on people and environment;
  - Incentives for environmental design substitutes, technologies and energy conservation;
  - Raising of green belts with pollution tolerant species;
  - Developing coping mechanisms for future climatic changes as a result of increased emission of carbon-dioxide and greenhouse gases; and
  - Appropriate action to control adverse impact on Indian continent due to ozone depletion and other gaseous effects in the atmosphere at global level.

It can, thus, be concluded that the scientific efforts to demonstrate severity of the problem of atmospheric pollution/build-up of green house gases has been well received at the political level. The strength of partnership and responsibility that had been demonstrated by several countries of the world at United Nations Conference on Environment and Development in Brazil in June 1992, to address global warming and the onslaught on biological resources, is the evidence of global political will. Although national and international efforts to curb the problem are going-on, individuals may also play a vital role simply by reducing their energy demand through its rational use.

Narayan Chandra Dash
Janardhan Pur Sasan
Keonjhar Bazar
Keonjhar - 750 002
ORISSA.

Sponge Iron Manufacturing Industry

Introduction

Sponge Iron is produced in Orissa Sponge Iron Ltd. by the direct reduction process. Its main fuel is coal. Since coal-based direct reduction process is a more viable proposition in India, the environmental hazards discussed here will pertain to coal-based direct reduction system only, although more or less the same pollution hazards are involved in the gas based direct reduction system.

The environmental hazards originate mainly at the following sections of a Direct Reduction Plant.

1. Raw material preparation
2. Ore Preparation
    1. Coal preparation
    2. Production handling

Control of Dust

Dust generation is the major problem of a Direct Reduction Plant. By adoption of any of several of the following measures dust emission can be controlled.

i. Reduction of the time of raw-material preparation and handling.

ii. Reduction of free fall of materials.

iii. Reduction of speed of crushers and grinders.

iv. Providing handling of materials in a closed system.

v. Use of closed bins for material storage.

vi. Use of pneumatic conveying system for fine materials.

vii. Providing suction points connected to a dust extraction system.

viii. Proper house-keeping.

In order to control the dust pollution, Orissa Sponge Iron Ltd. has taken up more positive steps and is continuously making efforts to bring down the levels of pollutants.

To control the dust emission at the various major dust emitting points, various types of dust extraction systems have been installed with multiple suction points to increase the efficiency of the extraction system.

The details of the system already installed are furnished below:

Sl. No.	*Locality*	*No. of Units*	*Types of Extraction System*	*No. of suction points*
1	2	3	4	5
1.	**Coal Preparation Unit** a) Coal Crusher b) Primary Screen c) Secondary Screen d) 1349 Conveyor e) 1374 Conveyor	1(one)	Scrubber System	8 Nos.
2.	**Cooler Discharge End** i) Product discharge from Cooler to pass ii) Coal Slinger	1	-do-	4 Nos.
3.	**Magnetic separator area**	1	Scrubber System	4 Nos.
4.	**Reactor discharge end**	1	--do--	1 No.
5.	**Ore crushing unit**	1	Bag fitter - type	

Control of Gaseous Emissions and Dust in Gas Reactor

Gas reactor

The gas cleaning system is in-built with the process and has been found to be most effective.

The gas reactor containing dust particles and combustibles enter a burning chamber (called after burner) where the combustibles burn in the presence of excess air to produce $C0_2$ gas. The combustion product containing dust particles and gases such as CO_2, N_2, NOx, SOx are passed through the quencher scrubber where the gases are dissolved in water. This gas cleaning system is quite efficient to control the dust and gaseous emissions.

Other measures

i. A tractor mounted water spraying system is in use to spray water on the road to prevent dust emission due to movement of vehicles.

ii. There is a green belt in and around the plant area containing mainly Eucalyptus, Akasisa, Sal wood trees, Mango, Guava, Gamhari, Teak Bamboo etc.

iii. Various environmental analysis have been done for the protection of dust.

iv. An occupation health centre has been provided in the plant premises and regular health check-ups have been done.

v. Provisions of providing nose masks and gas masks to the plant employees.

K.G. Gupta
Asst. Professor
Civil Engineering
D-6-D, Govt. Engineering
College Campus
Farmagudi - 403 401
GOA.

Iron Ore Mining in Goa

Introduction

Mining is regarded as the backbone of Goa's economy. In the name of the development of Goa, the authorities have damaged the ecology and environment to an extent which cannot be reverted. Vast areas in Goa are covered with mine rejects, resulting in the death of earth. Villagers dreaming of employment, betterment, growth in life styles and standards are left with dust, diseases, poor work-environments, ecological imbalances and what not!

The villagers want only two things - neither the employment, nor the development but they only need "FRESH AIR" and "CLEAN WATER" gifted by nature.

The statistics presented in the paper tell us about the severity of the problems of occupational and environmental health problems in Goa mainly due to mining operations.

MINING IN GOA

Goa, the crescent shaped state, covers an area of 3,720 sq. kms., and lies on the west coast of India. At present about 580 mining concession leases are in force covering an area of 500 sq.kms. (about 14% of the total surface area of the state). These mining concessions are situated on the hillocks surrounded by agricultural fields, horticulture grounds and forest lands.

The history of development of the mining industry in the state is well known. From a simple orthodox type of manual mining, the industry today, by and large, represents a very high degree of sophistication. The instrumentation has brought revolutionary changes not only in the economic sphere but also in the development of other ancillary industrial units. However, despite the fact that the industry has brought prosperity and gainful employment opportunities either directly or indirectly to a considerable segment of this territory, it has also paved the way for environmental degradation and ecological imbalance. Mining industry

is the backbone of Goa's economy, the dominant mineral resources being iron ore. Iron ore mining accounts for about 32% of the nation's iron ore production and about 55% of its export. Aided by a good water transport system and the proximity of Marmugoa port, Goa is able to compete in the international market for the export of low grade iron ore.

Mining activities started in Goa around 1940-50. The first decade of mining rested on manual operations. With the production and disposal picking up, the second phase of growth was marked by mechanisation. The last quarter of the century has seen the best of development in all aspects of mining, both above the surface of the earth and below. That the mining activity has gone below the watertable in some of the mines is an indication of the strides the industry is making. Mining which started as a minor effort of harnessing the natural resource has now become the vital force to stem the economy of the state by providing direct and indirect job opportunities.

The principal product of mining in Goa, in terms of production and also export, is iron ore. Though widespread, most of the ore is explored from mines in North Goa (about 10 million tones from sixteen major mines). In addition, ores of other minerals extracted in Goa include manganese, ferro manganese, bauxite, laterite, bricks, clay, river sand, lime shell etc.

Iron ore mining in Goa is critical to the economy of the state which has a total population of a little over one million. It covers around 4% of land area in the state. It is the largest industry employing nearly 20,000 workers. In addition, it is crucial to a number of other important activities including those associated with port, railways, barges, trucks and other maintenance workshops. Income to the State in the form of cess, panchayat tax, octroi, etc. is substantial. The port itself earns more than Rs.25 crores per year. Iron ore constitutes 5% of the country's total export and yields around Rs.550 crores per year in foreign exchange.

Mining Operations:

The mining operations leading to dust emission are:

1. Drilling
2. Blasting
3. Ripping and Dozing
4. Loading
5. Hauling
6. Processing

Drilling

Drilling a hard strata of rock contributes to particulate pollution due to the emission of fine particles and chips. From the point of air pollution, dry drilling contributes to pollution on a larger scale as compared to wet drilling.

Blasting

Blasting is affected by modern blasting techniques and drill pattern of holes. The blasting sequence is so designed that the dust formation is very little and is confined to the blasting site. Secondly, blasting is carried out mostly during the monsoon season when dust suppression is maximum. Water streaming and oil sprays are some of the devices and methods tested to allay dust from blasting.

Ripping and Dozing

Dust formation during ripping and dozing is negligible as it only involves pushing of material and is inherently incapable of raising dust except in the case of strong winds which do not occur frequently. Secondly, the ore has plenty of moisture and as such is not susceptible to rise.

Loading

In mechanised mines, shovels or front end loaders are generally employed for the purpose. Recently hydraulic excavators have been introduced.

Hauling

This is the operation which has the greatest potential to dust pollution and deserves special attention. The main source of dust during hauling is the crumbling of road surface due to improper construction and maintenance. This in turn leads to the formation of pot holes and undulations.

Effects of Mining

Areas where mining has been in progress for a long time are generally characterised by waste dumps rising often upto 50 to 100 m above the ground level. These dumps are fragile and ultimately get dispersed and eroded resulting in the fanning out of wastes.

Mining hazards are associated with the following factors:

(i) Sudden slump of waste dump and side walls of open pit.

(ii) Subsidence met within the underground mining.

(iii) Human negligence and error in use of explosives.

(iv) Mineral ore transport.

The most significant impact of surface mining on environment is the alteration of land surface with top soil removed, vegetation is not readily established on soils or on exposed rocks in the quarry. This results in the alteration of normal surface and sub surface drainage patterns.

Surface water may also be polluted by siltation. Streams are polluted by particulate or dissolved solids derived from rapidly eroding, unprotected waste piles. Extraction of mineral ores leads to other threats like landslides and soil erosion.

Effects on Plants

Effects of mining on plants have been highlighted by several researchers (Rao and Rao, 1989). The effects on plants can be studied with reference to damage to the entire plant or to specific parts. Accordingly, the following categories are generally identified.

i. Under conditions of intensive open cast mining, the entire plant structure gets affected due to constant deposition of particulates which form a physical barrier between plant and its ambient atmospheric cover. Destruction of habitat and large scale felling of endemic plants can also be included under this category.

ii. *Necrosis*: Necrosis is the killing or collapse of tissue.

iii. *Chlorosis*: Chlorosis is the loss or reduction of green plant pigment, chorophyll. The loss of chlorophyll usually results in a pale green or yellow pattern. Chlorosis generally indicates a deficiency of some nutrients required by the plant. In many respects, it is analogous to anemia in animals.

iv. *Abscission*: Leaf abscission is dropping of leaves.

v. *Epinasty*: Leaf epinasty is a downwards curvature of the leaf due to higher rate of growth on the upper surface.

The areas along the reject dumps are generally affected by dust wash off and overflows. In such areas, the vegetational cover is mostly affected by the dust deposition on leaves and flowers. The slime of silt affects the growth terms of vegetal cover and fruit production. The agricultural or plantation growth and yields from fields are affected adversely due to placing of mine rejects which do not allow growth of vegetal cover. This is harmful to vegetation especially in case of manganese ore rejects which have high iron - allumina content and dry up into a hard surface. The mine rejects flow into the surface drainage of roads resulting in a blockage which causes improper drainage of roads and pavements.

The vegetation of areas surrounding the mining region are adversely affected by dust

generated due to mining operations. The dust particles form a coating on the leaves and block the stomatal openings and affect the process of photosynthesis.

Effects on Human Beings

Mining, if uncontrolled can degrade the quality of life of people who live and work in the mining areas. Mining is historically one of the most hazardous of industrial occupations. Mining incurs physical, chemical, biological and mental hazards. Mining and related operations do pollute the atmosphere with particulate and gaseous substances. Danger of noxious gases and fumes are well known . They are released by constant activities and are hazardous to miners. Dust is generated at all the stages of mining operations and it pollutes the atmosphere affecting not only the miners but also persons inhabiting the surrounding areas.

The respiratory tract is mainly affected by the dust emitted during mining activities. The position and placement of dust deposits in the different parts of the respiratory tract is the function of the particle size. Dust particles reaching and remaining in the alveoli are believed to be in the range of 5 to 0.1p, 3p being the large particle in the alveoli. The majority of particles below 0.1p are thought to be too small to be trapped and are exhaled.

Mine atmosphere is generally polluted due to heat, humidity, dust and obnoxious gases. Regarding the limits for physiological considerations in human machine allocations, it was observed that in most of the cases limits crossed the discomfort zone (Woodson, 1992). It is no wonder that the miners working in such hostile environment usually become victims of various occupational diseases such as pneumoconiosis, silicosis, nystagmus, asthma, acute bronchitis, congestive old pulmonary diseases (COPD) and various parasitic diseases.

Prevalence of opthalmic diseases like defective vision, cataract, pterygium, conjunctivitis, corneal, ulcer, glaucoma, nystagmus and squint trachomo have been studied in 8 mines. A very high percentage of miners have some problems of the eye (29.06%).

Dust of all types in finer size is a major health hazards to miners. Inhalation of these dusts in larger concentrations for longer periods causes dangerous lung diseases among miners (e.g. pneumoconiosis and silicosis). Apart from pneumoconiosis, prevalence of tuberculosis, tropical eosinophilia and bronchitis have also been observed. Study in an iron ore mine also shows incidence of 23% causes of siderosilicosis.

Result and Discussion

Regarding the variations in the concentration of SPM during different months of the year and for different operations, it has been observed that the concentration in the later half

of April (776 pg/m^3) was the highest, while September recorded the lowest (79.575pg/m^3). The present observations sound logical since April and May are characterised by moderate wind speed which tend to retain the particulates in localised pockets and the rate of settling the particles will be maximum during the monsoon months. However the constrains values with similarity in trend has been recorded by several workers.

Regarding the concentration of sulphur dioxide during different months of the year and for different operations, it has been observed that the concentration in the later half of April (12 pg/m^3) was the highest, while March recorded the lowest (0.8.pg/m^3).

Peak concentration of 4.59 ug/m was recorded in the pre-monsoon period (January to April). However, another recent study indicated a peak value of 5.905 pg/m^3 during the pre monsoon months (Hegde et al., 1991). The lower value observed presently may be due to the moderate wind speed at the time of collection of samples. The present observations confirm value recorded by Hegde et.al, (1991) so far as the influence of the wind speed is concerned. However, changes in the direction of the wind appear to influence the ambient concentration. Thus, while the present values were recorded when the wind direction was ESE-SSW in contrast to Hegde et. al., (1991) SW-S.

Regarding the variations in the concentration of NOx in the different months of the year and for different operations, it has been observed that the concentration in the month of September (30 pg/m^3) was the highest, while April recorded the lowest (0.93 pg/m^3). Peak concentration of 24.66 pg/m^3 was recorded in the post monsoon. This value is significantly higher (over 100%) as compared to the peak value of 12.53 pg/m^3 reported by Hegde et.al., (1991). It is significant to note that the peak values of the present study contradict the earlier observations. Such contradictory values can be attributed to variations in ambient parameters, time of collection and method of analysis.

Concentration in pre-monsoon and monsoon periods were 14.57 pg/m^3 and 18 pg/m^3 respectively. In contrast to this, Hegde et. al., (1992) have reported lower concentration (8.24 pg/m^3 and 7.78 pg/m^3) in the monsoon (May to August) and post monsoon (September to December) respectively.

Regarding the variation in the concentration of NH_3 during different months of the year and for different operations, it has been observed that the concentration in the months of August (2898 pg/m^3) was the highest while December recorded the lowest (40.5 pg/m^3). Peak concentration of 2731 pg/m^3 was recorded in the monsoon period (May to August). Concentration of NH_3 during pre-monsoon and post-monsoon periods were recorded as 406.38 and 265.1 pg/m^3 respectively.

The present observations have not been compared with other reports for want of literature support. Despite the fact that NH_3 is highly soluble in water, the highest value has been recorded in the monsoon. This is understandable since the samples were collected near Zuari Agro Chemicals Limited - an industrial unit which manufactures fertilizers using ammonia apart from other raw materials. It is likely that the values higher than those recorded presently would be obtained if continuous analysis of air samples is made in the area.

Tables 4, 5, 6, 7 and 8 represent the number of cases registered suffering from congestive old pulmonary diseases (COPD), acute bronchitis (ACBR), asthma (ASTH), bronchitic asthma (BRASTH), bronchitics (BR) and tuberculosis (TB). These tables also indicate that in most of the age groups females suffer most.

Table 4 : No. of cases registered suffering from COPD.

COPD		*Age Group*			
		1-20	21-40	41-60	Above 60
1991	Male	2	2	1	0
	Female	1	3	0	0
1992	Male	0	0	1	0
	Female	0	0	0	0
1993	Male	0	1	1	0
	Female	0	1	0	1

Table 5 : No. of cases registered suffering from acute bronchitis (ACBR)

BR		*Age Group*			
		1-20	21-40	41-60	Above 60
1991	Male	13	7	31	6
	Female	21	22	15	9
1992	Male	14	10	27	6
	Female	15	13	9	0
1993	Male	7	13	29	4
	Female	24	24	28	5

Table 6 : No. of cases registered suffering from asthma (ASTH)

ACBR		Age Group			
		1-20	21-40	41-60	Above 60
1991	Male	11	3	3	2
	Female	16	4	2	0
1992	Male	19	9	4	2
	Female	13	3	3	0
1993	Male	20	9	10	0
	Female	33	11	6	3

Table No.7 : No. of cases registered suffering from bronchitis (BR)

BRASTH		Age Group			
		1-20	21-40	41-60	Above 60
1991	Male	3	6	31	6
	Female	10	18	14	8
1992	Male	5	7	13	4
	Female	5	4	4	0
1993	Male	2	5	21	0
	Female	9	18	21	2

Table 8 : No. of cases registered suffering from tuberculosis (TB).

ASTH		Age Group			
		1-20	21-40	41-60	Above 60
1991	Male	2	0	1	0
	Female	0	1	0	1
1992	Male	2	5	6	0
	Female	1	2	0	0
1993	Male	1	4	4	0
	Female	0	3	7	0

References

1. *Key M.* (1971) "Dust and Pneumoconiosis".
2. *Dr. Senguptha B.K.* (1981). "Dust and Pneumoconiosis".
3. *Rao M.R. and Vidyarthi D.* (1981) "Safety and Environmental Control in mineral industry in India".
4. *Mahambre S.J.* (1986) "Remedial measures and recommendations for proper environmental management in iron ore mining areas, Goa".
5. *Verma and Lobo B.L.* (1986). "Pollution control and ecology restoration in Sesa Goa mines".
6. *Dogra R.K., Shanker R. & Zaidi S.H.* (1987) "Significance of particulate load in lungs and lymph nodes of animals in the mining area". ***Ind. J. of Env. Health Vol.291 (2)***
7. *Khoshoo* (1988) "Environmental concerns and strategies" ***Ashish Publishing House, New Delhi.***
8. *Dr. Maudgal S.* (1989). "Mineral development and environmental management".
9. *Paliwal H.V.* (1989) "Managing and environment".
10. *Triggs D. and Bertram T.* (1989). "Strategy for environmental management in mining and associated operation".
11. *Rao M.N. and Rao H.V.N.* (1989). "Air pollution". ***Tata McGraw - Hill, New Delhi.***
12. *Hegde V. and others* (1991) "Air pollution studies in Vasco".
13. *Prof. Khanna P.* (1992) "Policy options for environmentally sound technology in India". ***(IE (1) Bulletin Vo.41.***
14. *Woodson and others* (1992). "Human factors design engineering", ***McGraw-Hill Publ. New York.***

Dr V.S. Patwardhan and
Mr. B.K. Mishra

Cement Manufacturing Industry

Introduction

There is a health difference between rural and industrial population as far as nutritional status, physical work, smoking habits and so on are concerned. Also, the quality of air to which they are exposed can vary. The stress factor is also responsible for variation in physiological value and capacities of the individuals.

Occupation in the industrial area is better organised, with well defined energy sources. In the rural sector, the main occupation is agriculture.

Materials & Methods

The study was done in May & June, 1994. This study population consisted of 76 employees of Gujarat Ambuja Cement, Suli Project, 40km. away from Shimla (Himachal Pradesh). The project staff included officers, workers and security guards. Among the villagers, we included male/female members of the family on house to house basis.

Lung Function Test

A portable spirometer and MIC (Maximum Inspiratory Capacity) meter was used. Forced expiratory volume and maximum inspiration volume were noted. The subjects were given prior demonstration and a mean of three readings was considered valid. The average values according to the age, smoking etc. were recorded and compared between the two groups. (Ref. enclosed Table I & II) Children, chronic ills were not counted.

Table-I

Parameter	*Employees Nos.76*	*Villagers Nos.135*	*Difference*	*Percentage Difference*
Age (yrs.)	31	39.71	- 8.7	- 28
Height (Cms.)	161.85	153.05	+ 8.79	+ 5.43
Weight (Kgs.)	60.50	45.17	+15.33	+25.33
Max. Inspi. capacity (ml.)	1393.21	727.40	+665.80	+47
Forced expt. vol. (ltrs.)	2.75	2.52	+0.23	+8.3

Table 1 shows physical parameters and lung function test values both in industrial and rural population groups. Many older age group men and women were examined in villages and hence, the average age in that group is high.

The employees in general were found to be better built (higher weight and height in the 1st group). This could be explained by better economic status, better food and facilities. Younger age was also contributory.

Better lung functions were found among employees. The reasons could be as above.

Table - II

Parameters	*Employees*			*Villagers*		
	Non-Smoker	*Smoker*	*Percentage Difference*	*Non-Smoker*	*Smoker*	*Percentage Difference*
Max.Inspi. Capacity(ml.)	1472.03	1468.75	0.002	861.81	801.66	7
Forced expi. Volume (Litrs.)	2.76	2.70	2.1	2.54	2.49	1.96
Systolic blood Pressure	124.54	124.37	0.13	126.02	126.86	-.01
Diastolic Blood pressure	80.67	81	0.11	81.76	79.93	0.02

The above table shows that –

a) *Among employees*: Lung functions of non smoker was better than the smokers. Systolic and diastolic blood pressure averages were found almost identical between smokers and non smokers.

b) *Among villagers*: Force expiratory volume and maximum inspiratory capacity was lower among smokers. 10 to 15% of women are found to smoke 10-15 beedies per day. Blood pressure difference was statistically not significant.

The study reveals that the physical build and nourishment was better in the industrial worker group, notwithstanding the fact that the village population in this area are robust and are used to hardship, very cold climate etc.

Chronic illness in both the groups is infrequent. The incidence of pulmonary tuberculosis was found to be very low among both the groups. No case of pneumoconiosis, bronchiactasis

and other major lung diseases could be located. However, smoking has been shown to jeopardise the lung functions in both groups.

Blood pressure readings among employees revealed as many as 10 cases of hypertension. The incidence of hypertension among villagers was low. We could not find any specific relation of smoking with B.P. readings.

The location of the project was in the tough mountains of Himalayas. Also, most of the villages were situated on individuals hills. The co-operation from the people was excellent. The weather was unpredictable and very cool, (Temp. less than 10-15 degrees) except in the two months of summer. To do a health survey in this difficult but breathtakingly beautiful terrain, has been a unique experience.

Dr. G.S. Pandey
Reader
School of Studies in Chemistry
Ravishankar University
Raipur - 492 010
MADHYA PRADESH

Bronchial Contamination with Toxic Metals in Mineral Based Industries of India

Introduction

Sample Collection: The samples of bronchial washouts related to diagnosed cases of respiratory ailments collected at the Health Centre of Bhilai Steel Plant during Dec. 1992-July, 1993. The samples were collected on the basis of recorded medical-data of the subject concerned, and categorised industrial area-wise as follows : steel plant (Bhilai), thermal power plant (Korba), cement plant (Jamul), lime stone mines (Nandini) and iron ore mines (Bailadila and Rajhara). The subjects were further divided into sub-categories of workers and non-workers related to the respective industrial plants and their area. Five samples under the workers category and the same number under the non-workers category were picked up from the lots related to the above stated industrial areas. Five more samples related to the subjects from uncontaminated areas situated more than 100 Km. away from any industrial unit were also collected. The samples under workers category belonged to only males (21-56 years) whereas those under non-workers category belonged to males and females (21-67 years). The bronchial washout samples were collected using a fibre optics bronchoscope (Olympus, Model BF-XT20) with attached camera and brush. The brushed and the scrapped deposits were dipped into saline (0.9% NaCl solution). 25 ml of the saline was used in each bronchioscopic case.

Effects of toxicants in workers

The results obtained (Table 2) have provided discernible patterns of occurrences of the selected toxic metals in the respiratory tracts, showing distinct impact of the industrial areas to which the subjects belonged. The data obtained have also shown a marked difference in the occurrence of the toxic metals in the categories of the plant-workers and non-workers related to the respective industrial areas. The data obtained have a wide range of values e.g.

54.3 mg in case of Zn and 0.2 mg in case of Cd. In several cases, the values of the toxic metals have been found to be undetectable. The discussion on the analysis data is, therefore, confined to only those values which have been found to be higher than the specified values of the detection limits of the respective toxic metals. Accordingly, the highest loading of the respiratory tracts by the toxic metals was found in the subjects related to the steel industry. The mean levels of occurrence of toxic metals in the respiratory tracts of the workers category of this industry were as follows (ppm): Pb-15.2, Cu-39.1, Cr-6.6, Cd-0.6, Co-2.9, Ni-12.8, Mn-4.8, Zn-49.2. The contributory effect of various industries on the deposition of the toxic metal was found in the following order: steel plants, thermal power plants, cement plants, iron ore mines, limestone mines and non-industrial areas.

The plant-workers category of the subject in the respective industrial locations showed a higher presence of metals compared to the non-workers category living in the same industrial areas. The subjects related to coal-fired industries (steel plants, thermal power plants and cement plants) indicated higher presence of toxic metals compared to the non-coal-fired industries (iron ore mines and limestone mines), suggesting that the stack emitted particles were additional and also potential carriers of the toxic metals. The presence of these toxic metals in the fly ash of the thermal power plant where coal is the only material used was reported earlier (Patel and Pandey, 1985, 1985a).

The subjects related to non-industrial areas or apparently uncontaminated areas showed only a small presence of toxic metals, suggesting that the mineral materials handled in industries make a decisive contribution to the depositions in the respiratory tracts. In all the cases studied, Zn, Cu and Pb showed high tendencies of reaching the respiratory tracts, while Cd, Co and Mn indicated comparatively lesser tendencies. The behaviour of Ni and Cr was found to be varying. However, the extent of occurrences of the toxic metals in the respiratory tract would depend on factors such as their relative presence in the materials processed, the particulate matter emitted, and on the enrichment factors of the toxic metals in the respirable size-range of the emitted particles. The occurrences in the respiratory tracts, in general, have been found to be higher in the higher age group of the subjects. In the non-workers category, the male:female ratio of the subjects showing contamination of the respiratory tract was found to be 2:3, indicating slightly higher susceptibility of the females for respiratory damage in the areas of mineral - based industries.

The disease-wise distribution amongst 25 diagnosed cases of respiratory ailments under the plant-workers category, who indicated high deposition of toxic metals was as follows: tuberculosis-7, bronchitis-11, and lung cancer-7. Although the incidence of bronchitis was found to be higher, any correlations between the diseases diagnosed and relative presence of toxic metals could not be made on the basis of the available data.

References

Patel, C.B. and Pandey, G.S. 1985. Determination of selected metals (Al, Fe, Cr, V, Mn and Mo) in Fly Ash Fallout from Thermal Power Plant. ***Indian Journal of Environmental Protection, 5, (1).***

Patel, C.B. and Pandey, G.S. 1985a. Dissemination of Toxic Metals through Thermal Power Plants Fly Ash Fallout. ***Indian Journal of Air Pollution Control, 6 (1), 15-24.***

Richard, J. Thomson, B., George, M., and Lazzy, P. 1970. Analysis of Selected Elements in Atmospheric Particulate Matter by Atomic Absorption. ***Atomic Absorp. New Letter, 9 (3).***

Seth, P.C. and Pandey, G.S. 1983. Lead Fallout from Steel Plant, ***National Academy of Science Letters, 6 (1) 11-16.***

Seth, P.C. and Pandey, G.S. 1983a. Nickel, Zinc, and Copper in Particulate Fallout from Steel Plant. ***Indian Journal of Environmental Protection, 3 (1) 99-101.***

Seth, P.C. and Pandey, G.S. 1983b. Analysis of Selected Metals in Cement Plant Dust Fallout. ***AURA, 5, 19-20.***

Seth, P.C. and Pandey, G.S. 1984. Determination of Selected Metals in Steel Plant Dust Fallout. ***Journal of Institution of Engineers (India), 64, Pt. MM3.***

Van Loon, J.C. 1980. Analytical Atomic Absorption Spectroscopy for Selected Metals. ***Academic Press, New York, 60-70.***

Varian Publication. 1989. Flame Atomic Absorption Spectrometry-Analytical Methods. ***Varian Techtron Pvt.Ltd. Publn. No. 85-10000-00, Mulgrave Victoria (Australia).***

Dr. Apurba Kr. Chakraborty
Indian Oil Corporation Ltd.
Assam Oil Division Hospital
P.O. Digboi, Dist. Tinsukia
ASSAM - 766 171.

Lung Function Status of Workers Exposed to Coke Dust

ABSTRACT

Lung Function Status of equal number of smokers and nonsmokers amongst the coke chamber and non coke chamber workers between ages 22 & 46 of a 60 years old coking unit of the nation's oldest refinery was determined by measuring percentages of Forced Vital Capacity (FVC) & Forced Expiratory Volume in one second (FEV_1) against predicted values. FVC & FEV_1 percentages against predicted values were also determined for equal number of shop keepers running shops by the side of a national highway passing by the side of the oil township. The mean FVC & FEV_1 of non smokers were clearly more than those of the smokers. Amongst the smokers, the coke chamber workers revealed better lung function. The non smoker group of coke chamber workers revealed better lung function than non-smoker group of shop keepers on light jobs but exposed for 8-10 hours a day to the environment of the main road, the rate of vehicular (both petrol & diesel) movement on which was only 3-5 minutes.

This observation raises the following questions:

A) Are the roadside shop keepers more vulnerable than even the workers exposed to coke dust ?

B) Has the greater physical activity amongst the present groups of coke chamber workers contributed to better lung function ?

A study on a bigger size (population) may help in drawing a conclusion.

Introduction

The coke which is produced from the heavier stocks of the crude oil after distillation, is extracted out from inside the coke chambers by the workers manually. For complete emptying of one coke chamber, the workers involved stay approximately six hours inside the chamber

for scaling of coke from the chamber wall, fixing cables for the next operation and other necessary work. All those who work in this plant either inside the coke chamber or outside are exposed to coke dust every day.

It was interesting to note that coke chamber workers (both smokers & non-smokers) maintained better lung function than the roadside shopkeepers and those working in the same plant but outside the coke chambers.

The number of workers being very small and the group being a mixture of different ethnic origin, no racial criterion could be linked to the better lung function of the coke chamber workers. Could it be due to the higher level of daily physical labour ? A study on a much bigger sample may help in better understanding of the results of this present study.

Fifty coke chamber workers and non-coke chamber workers of the Dubbs Coking Unit were clinically examined to screen out presence of any current respiratory tract infection. Those having any recent history of respiratory tract infection or convalescing were not included in the test. Similarly thirty shop keepers from various occupations, having shops within 20 feet of the road margin, all facing the road directly were similarly screened. All these three groups, i.e., coke chamber workers, non-coke chamber workers and roadside shopkeepers were segregated into non-smoker and smoker groups.

All the subjects under the present study were tested for lung function within a particular period of the month of July when the ambient temperature fluctuations were not more than 1°C. All the subjects were first informed about the role to be played during the testing process. The highest reading of FVC & FEV_1 of the three consecutive tests in maximum possible motivation were considered. The mean values of FVC & FEV_1, in the smokers and non smokers from all the three groups were converted to and considered in this study. The tests were carried out using the same spirometer all through, after standardisation from time to time.

The relevant and simple data regarding dust particle level, SO_2 level and NOx level were collected from the Quality Control Department of the refinery.

Air samples were collected from inside the coke chamber at different phases of scaling operation from breathing zones of the workers using stack monitoring kit (600, by ENVIROTECH, New Delhi) and tested for suspended particulate matters by the gravimetric method. From coke unit premises and township road air samples were collected from multiple areas using a high volume sampler and tested for SO_2 & NOx.

All the tests were carried out by experienced and senior chemists of the Quality Control Department of the refinery.

Results

Table No.1 shows levels of SPM, SO_2 & NOx at different locations. SPM level inside the coke chamber is very high, about 2453 times higher than that of the general plant area outside the coke chamber & 638.46 times higher than that of the township road. Sulphur dioxide level is highest inside the coke chamber and lowest at the township road. This is because of production of some amount of SO from the hot coke which contains Sulphur. NOx level is highest along township road because of automobile exhaust.

Table 2 shows mean FVC & FEV_1 amongst the three groups of non-smoker workers i.e. coke chamber workers, non-coke chamber workers and roadside shop keepers. Coke chamber workers have revealed better results than the other two groups. However, there is little or insignificant difference between the non-coke chamber workers and roadside shopkeepers.

Table 2 shows mean FVC and mean FEV_1 amongst the three different smoker groups. Amongst the smoker groups, the coke chamber workers again revealed better results than the other two groups. However, the present group of roadside shop keepers revealed better lung function than non-coke chamber workers.

Table 4 shows FVC & FEV_1 patterns showing number of workers in percentage amongst smoker groups. More than 50% of chamber workers have FVC more than 90% compared to 16.66% and 40% amongst non-chamber workers and roadside shop keepers respectively. 50% of the non-coke chamber workers show FVC between 70% - 80%. In the present group of roadside shop keepers, 50% have FVC between 80% - 90%. Only 5.56% of coke chamber

Table-1 : Suspended particular matter, Sulphur dioxide and Oxides of Nitrogen level at different locations

Eight hours average, in Mgm/M³			
Air Pollutant	*LOCATIONS*		
	Coke Chamber	*Outside Coke Chamber*	*Roadside*
SPM	2,00,000 (80,000-4,00,000)	81.5 (71.00-90.00)	313.25 (264-389)
SO_2	40 (10-50)	26.25 (29 - 41)	30.75 (21 - 46)
NOx	80 (46-82)	76 (56-101)	114 (89-149)

Table 2 : Mean FVC & FEV_1 percentages against predicted values for different groups of workers against control

(Non -Smokers)

Pulmonary Function Parameters FVC & FEV_1 %age against Predicted values	*Control*	*Coke Chamber*	*Dubbs Coking Unit Workers Non-Coke Chamber*
Mean FVC	99.2 (±8.62)	96 (±11.41)	88 (±4.98)
Mean FEV_1	98.15 (±8.42)	92 (±10.22)	87 (±5.90)

Table 3 : Mean FVC & FEV_1 percentages against predicted values for different groups of workers

(Smokers)

Pulmonary Function Parameters	*Dubs Coking Unit Workers*		*Roadside Shopkeepers*
	Coke-Chamber Workers	*Non-Coke Chamber workers*	
Mean FVC	92 (±14.2)	81.16 (±11.07)	87.75 (±6.61)
Mean FEV_1	88 (±16.12)	78 (±12.71)	81.62 (±8.99)

workers with smoking habit have FVC less than 70% against 16.66% amongst non-coke chamber workers. In the present study group, no shop keeper had FVC less than 70%. Also, only 10% shop keepers had FVC in the range of 70% - 80% against 16.67% & 50% in coke chamber and non-coke chamber workers.

33.32% of chamber workers have more than 90% FEV_1 compared to 16.66% and 30% in the non-coke chamber workers and roadside shopkeepers respectively. 40% of the present group of smoker shop keepers have FEV_1 in the range of 80% - 90% compared to 22.24% & 33.34% in the coke chamber workers and non-coke chamber workers respectively. 10%

Table 4

FVC & FEV_1 Patterns in percentages amongst different groups of workers

(Smokers)

Pulmonary Function Parameters Percentage against Perdicted Valued		*Dubs Coking Unit workers*		*Road side Shopkeepers*
		Coke-Chamber Workers	*Non-Coke Chamber workers*	
	< 70%	5.56%	16.66%	Nil
FVC	> 70-80%	16.67%	50.00%	10%
	> 80%-90%	22.24%	16.66%	50%
	> 90%	55.53%	16.66%	40%
	< 70%	16.67%	16.66%	10%
FEV_1	> 70%-80%	22.77%	33.34%	20%
	> 80%-90%	22.24%	33.34%	40%
	> 90%	33.32%	16.66%	30%

shopkeepers shows FEV_1 upto 70%, against 16.67% and 16.66% in chamber workers and non chamber workers respectively.

Table 5 shows distribution of different non smoker groups in percentages against different FVC & FEV_1 range against control (a group of volleyball players - all non smokers in practice for one month).

None amongst the non smokers in any group had FVC < 70%, 70.59% of the coke chamber workers had FVC 90% - 100% range against 10% and 50% in the non-coke chamber workers and shopkeepers respectively. 33.34% of road side shopkeepers had FVC in the range of 70% - 80% compared to only 5.88% in the coke chamber workers. 90% of the non-coke chamber workers shows FVC in 80% to 90% range against 23.53% & 16.66% in the coke chamber and road side shopkeepers respectively. However, none from amongst these three groups had FVC more than 100% as against 30.76% in the control group.

Percentage of workers having FEV_1 in the range of 80% - 100% are 100% for Coke Chamber Workers, 90% for non-coke chamber workers & 66.66% for road side shop keepers respectively. 16.66% of road side shop keepers & 10% of non-coke chamber workers have FEV_1 between 70% - 80%. Amongst shopkeepers, 16.68% have FEV_1 less than 70% against 0% in other two groups.

Table No. 5
(Non-Smokers)

Pulmonary Function Parameters Percentage against Perdicted Valued		*Control*	*Dubs Coking Unit workers*		*Side Shopkeepers*
			Coke-Chamber Workers	*Non-Coke Chamber workers*	
FVC	< 70%	Nil	Nil	Nil	Nil
	> 70%-80%	Nil	5.88%	Nil	33.34%
	> 80%-90%	23.07%	23.53%	90%	16.66%
	> 90%-100%	46.15%	70.59%	10%	50.00%
	> 100%	30.76%	Nil	Nil	Nil
FEV_1	< 70%	Nil	Nil	Nil	16.68%
	> 70%-80%	Nil	Nil	10%	16.66%
	> 80%-90%	23.07%	52.94%	60%	16.66%
	> 90%-100%	38.47%	47.06%	30%	50.00%
	> 100%	38.46%	Nil	Nil	Nil

Table 6 shows mean FVC & FEV_1 of smoker shop keepers doing physical exercise for 2-15 years. Mean FVC & FEV_1 are 99% & 98% respectively. Number of shop keepers in this category being very small, giving a comment on this result needs only further study with bigger sample size.

Discussion

This study shows the present group of coke chambermen who are apparently exposed to a very dusty environment with minimum ventilation have maintained better FVC & FEV_1. This may be due to the following reasons :

Table 6
Mean FVC & FEV_1 of Smoke Shopkeepers doing Daily Physical Exercise
(Freehand/Yogasana/Karate/Swimming) for 1 Hour-1 1/2 Hours for last 2-15 Years

SAMPLE 5

Parameters in percentages of predicted values	*Mean values*
FVC	99%
FEV_1	98%

(a) The respirable dust particle concentration inside the coke chamber is lower than that at roadside. As size selective sampling of the air could not be done, this point could not be confirmed.

(b) Total duration of daily actual exposure

of the chambermen to the chamber environment is hardly more than half the roadside shopkeepers' duration of exposure.

(c) Regular higher level of physical activity - this factor appears in our mind as chambermen have revealed better FVC & FEV_1 than the non-chambermen group of the same plant. It is a remote possibility that chambermen are exposed to lower concentration of respirable dusts than even the non-chambermen as non-chambermen are always enjoying much better ventilation throughout their working period.

Distinct differences in FVCs & FEV_1s due to smoking have been noted amongst the chambermen & non-chambermen groups. However, the differences in FVCs & FEV_1s as noted in the smoker & non-smoker groups of shopkeepers need further study on a bigger sample for better understanding. However, the present group of shopkeepers were mostly habituated to smoking rate not exceeding 3-4/day as against other two groups i.e., chambermen & non-chambermen smokers whose smoking rates for 5-20 years were 2-6 times higher than the present groups of smoker shopkeepers.

Lastly, a small group of shop keepers who were regularly doing physical exercises for 2-15 years revealed surprisingly high FVC & FEV_1. Though this group constituted a small percentage of total number of shop keepers under study, the factor of extra daily physical labour in their case points out towards possibility of its contribution to higher FVC, FEV_1.

As base line lung function data for these workers were not available, the effect rate of a particular environment on the lung function of a particular group of workers over a particular period of time could not be assessed.

Inspite of many limitations and small sample size, this study has again pointed out very strongly the deleterious effect of smoking along with the possibility of beneficial effect of physical exercise on the lung function.

The author is very much conscious of the total limitations with which this study was made. Hence no attempt has been made to compare the results of this study with similar other works if done elsewhere on bigger samples with more sophisticated equipment.

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P. K. Das
Vice Chairman
National Safety Council
W.B. Chapter & Secretary,
Steel Workers Federation
of India
Durgapur.

Steel Manufacturing Industry

Introduction

The principal man made problems of dust come from the growth of factories in India. Problems of dust aggravating every day throughout the length and breadth of the country. To get an idea we can examine the growth of some industries over last 40 years which specially contribute to generation of dust.

Many factories or products increased 25 times to 800 times during last 40 years. Here are few brief statistics of 7 principal industries which have specially dust prone production processes.

Industry

Units 1951 1981			
1. Coal	Lakh Ton	328	2193
2. Steel	-do-	17	121
3. Cement	-do-	27.3	482
4. Nitrogen Fertilizer	Thousand Ton	9	7045
5. Jute	-do-	837	1428
6. Textile	Crore Kilo	421	1006
7. Electricity Generation	Crore Kwh	530	26,423

Mini Steel Plants generally use obsolete technology to produce at bare minimum cost, not by bringing efficiency in the use of raw material, power fuel, lubricant etc. but by reducing cost on manpower, anti pollution measures, safety, health and work environment. Taking for granted that safety and pollution control measures only increase cost, the owners find it prudent to use obsolete and manpower based technology. Naturally, pollution is serious in mini steel plants.

Integrated steel plants are a complete production process from raw material handling to finished products. For obvious reasons, areas of dust generation are many in number and serious in magnitude. We are presenting a brief report on the dust prone processes.

a) Wagon Trippler unload raw material and coal from wagons which give rise to huge amounts of ore and coal dust.

b) Coal crusher and hammer mill grind coal to dust to increase its burning efficiency but is a serious dust hazard for workmen working in hammer mill and nearby areas.

c) Coal and ore handling, blending, transferring process give rise to dusts.

d) Coke Oven charging and pushing of pulverised coal cause huge spillage and dust pollution.

e) Sinter Plant is a process to make sinter from coal, ore dolomite and lime fines. This is a highly dusty process and workers have to work under extremely difficult conditions.

f) Blast Furnace charging and gas cleaning system pollute dust throughout the area.

g) Lime and dolomite klin cause dust spillage from Klin and conveyors.

h) Refractory cutting, grinding, sizing plant generate dust.

i) Steel Melting Shops pollute the area of 5 to 20 km radius with dust from desilicosing plant, desulpherisation plant, and also from steel melting furnaces.

j) Captive and hot blast power plant also throw dust in area of radius upto 20 km.

k) Moulding, knocking, grinding process in foundry cause serious dust generation.

l) Lime calcination plant also pollute lime dust in nearby areas.

m) Ammonia sulphate plant cause chemical dust pollution for the workmen working in this area.

Problems of pollution in and around steel plants are so high that it needs an elaborate study concerning effects on health of the workmen and members of public of nearby locality. In bigger steel plants with production capacity of more than one million tons per year, the effect is enormous. In the history of indian steel industry, the Steel Authority of India conducted a limited study on the workmen of blast furnace employees which revealed several factors on the health of target workmen.

Fertilizer plants also cause chemical pollution from ammonia sulphate, nitrogen phosphate fertilizer etc. Since chemical dusts are generally heavier than fly ash or ore dusts, its effects are limited.

With the massive growth of coal fired power plants in India, the pollution problem is also becoming serious. Almost all old power plants do not have electrostatic precipitator (ESP) for catching dust at source. Tons of dust emit from its chimneys and spread towards the wind direction. Since most of the thermal power plants are located near cities, lakhs of people have to inhale the fly ash through the normal respiration process. Major component of this

dust is below 5 micron sand so no protective device can work in practice.

Even when ESP are working, the dust mixed with water is discharged into the nearby river. Very very fine dust does not settle down in the water and the people are compelled to consume the contaminated drinking water.

Dusts arising out from paper, carbon black, graphite etc. plants also constitute a sizeable amount of dust in the regional basis.

Another important pollution problem arises from the cement industry. Demand of cement industry is likely to grow in the future due to an open market economy with export potentials, as developed countries try to avoid any pollution prone factory at home. Keeping this in mind, the estimated rise in cement production is from 4 MT to 96 MT within 2000 AD. Very fine lime content in cement spreads quickly through air direction and forces nearby people to inhale. Its effect both on workmen engaged in factories and handling process along with public in the vicinity is serious.

Thousands of foundries are potential sources of air pollution due to recycling of sand used in moulds. Apart from pure silica sand, very dangerous chemicals are added as bonding materials. Those are hydrogen chloride, isopropyl alchohol, bentenite etc. Very fine sand dust mixed with chemicals is inhaled by the workmen who suffer from serious diseases.

Another major dust hazard industry is the pigment factory. Colourful dust is very very fine in nature and rich with dangerous chemicals. Since it is below 3 microns in size, it finds no barrier to reach the lungs and other respiratory tracts.

It is very difficult to mention elaborate examples of dust hazards caused from factories. Dust coming from above sources causes following diseases in workmen and members of the public. They are bronchities, respiratory trouble, asthma, cancer and so on.

With the development of industry, operation in mining and quarries has also increased manifold. Iron ore, coal, bauxite, lime stone, silica, mica etc. are taken away from mother earth either by cutting or blasting. Explosion, handling and transportation spills huge dust in mine areas. Dwelling houses, trees and roads are covered with fine dust. Manual loading from mine to stack, stack to wagon, movement of dumpers, continuously spray dust in the entire area and people have to live with extreme difficulty specially during the dry season.

Loading and unloading of minerals, cement pigments etc. and screening, grading, stacking are mainly done by illiterate poor persons who have no knowledge about its nature and effect on health. Roads, terrains are covered with dust. During dry storms air is fully loaded with mineral dusts and people get no fresh air to breathe.

Abbreviations

BOD	=	Biological Oxygen Demand
CFC	=	Chloroflow Carbon
CO	=	Carbon Monoxide
CO_2	=	Carbon Dioxide
COD	=	Chemical Oxygen Demand
EPA	=	Environment Protection Agency
ESIC	=	Employees State Insurance Corporation
ESIA	=	Employees State Insurance Act
ESIS	=	Employees State Insurance Scheme
FEF	=	Forced Expiratory Flow
FVC	=	Forced Vital Capacity
FEV_1	=	Forced Expiratory Flow Volume in one sec
PEFR	=	Peak Expiratory Flow Rate
FVC	=	Forced Vital Capacity
H_2SO_4	=	Sulphuric Acid
HCL	=	Hydrochloric Acid
ICMR	=	Indian Council for Medical Research
ITRC	=	Industrial Toxicology Research Centre, Lucknow
LPG	=	Liquid Petroleum Gas
MIC	=	Methyl Iso Cyanide
NEERI	=	National Environmental Engineering Research Institute, Nagpur
NO_x	=	Oxides of Nitrogen
NGO	=	Non-Governmental Organisation
NIOH	=	National Institute of Occupational Health, Ahmedabad
OCCR	=	Orissa Cement & Refractory Ltd. Rajgangpur
PAH	=	Polynuclear Aromatic Hydrocarbons
PFT	=	Pulmonary Functions Test
PIFR	=	Peak Inspiratory Flow Rate
PPE	=	Personal Protective Equipments
SAIL	=	Steel Authority of India Limited
SO_2	=	Sulphur Dioxide
SO_x	=	Oxide of Sulphur
SPM	=	Suspended Particulate Matter
TB	=	Tuberculosis
TLV	=	Threshold Limit Value
UNCED	=	UN Conference on Environment & Development
UNEP	=	United Nation Environment Programme
VDU	=	Video Display Units
WHO	=	World Health Organisation

List of Participants

1. **H. Vikesh Dhanajaya**
D-2/15, Tridal Nagar
Yerwada, Pune - 411 005.

2. **Mr. M. Pradish**
120, Vijaya Nagar, BCML Nagar
Kolar Gold Fields - 563 115
Karnataka

3. **Dr. U.S. Patwardhan/Mr. B.K. Mishra**
Ambuja Hospital
Gujarat Ambuja Cement Ltd.
Ambuja Nagar, Kodinar
Dist. Amreli, Gujarat - 362 715.

4. **Mr. Sunil Kr. Mittal**
Near Daily Market
Post Rajgangpur
Dist. Sundergarh - 770 017
Orissa.

5. **Mr. Priyank Jain**
M-77/857, Chandnigate
Opp. Akashganga Flats
Narangpura
Ahmedabad - 380 013.

6. **Mr. Dharmendra Kumar**
S/o Shri Saryug Mistry
At & P.O. Noorsarai
Distt. Nalenda
Bihar - 803 113.

7. **Ms. Smita R. Menon**
C/o Rajshekhar Menon
A6, Meera Housing Society
Near Hathibhai Nagar
Old Padra Road, Divalipura
Baroda- 380 015

8. **Dr. Shashikala**
Pushpa Nailaya
Vidya Nagar III Cross
Mandya - 571 401.

9. **Mr. Prunami Patri**
Geologist
Mining Corporation Ltd.
Bhubaneshwar - 751 001
Orissa.

10. **Dr. Udai Raj Singh & Dr. Beena Singh**
F-1/27, 1100 Quarters
Bhopal - 462 016
Madhya Pradesh.

11. **Dr. S.K. Sharma**
Addl. Professor
Deptt. of Medicine, AIIMS
New Delhi - 110 029.

12. **Dr. G.S. Pandey**
Reader, Ravi Shanker University
Raipur - 492 010
Madhya Pradesh

13. **Ms. Winnie A. Saldanha**
A-16/19, Best Nagar II
Goregoan West
Bombay - 400 104.

14. **Mr. J. Jiju**
S/o S.S. Pillai
PWD & Railway Contractor
Site No. 27, 2nd Avenue
Port Employees Housing Society
Hosbaettur - 574 176

15. **Mr. Ajai Kumar**
VII-191, Nehru Bazar
Madanpalli, Chittoor
Andhra Pradesh.

16. **Mrs. Girija Prakash**
186/396, Maharishi Valmiki Road
Mumfordganj
Allahabad - 211 002
Uttar Pradesh.

17. **Mr. Gurunathasa P. Bhandage**
C/o Ambasa Kabadi, Bakalo
Galle, Ganesh Perth
Hubli - 580 020.

18. **Mr. S. Sivanangai**
4, Sagar Apartments
5th Avenue, Besant Nagar
Madras - 600 090.

19. **Mr. Nadikant**
Plot No. 90
Shantiniketan Society
Mahindra Hills, East Maredapally
Secundrabad - 500 026
Andhra Pradesh.

20. **Indranil Chakraborty**
27, Haffezullah Berh
Kalua Road, P.O. Pirpukar
Distt. Burduwan
West Begal - 713 101

21. **Mrs. P. Pati**
R & D Unit
Orissa Mining Corporation Ltd.
Bhubaneshwar - 761 001
Orissa.

22. **Sudhakar Velagada**
G-32A, New Colony
P.O. Tatni, Dist. Khurda
Khurda Road - 752 050
Orissa.

23. **Shanpa Chatterjee**
Vidya Niketan Hostel
Regional College of Education
Shyamala Hills
Bhopal - 462 013.
Madhya Pradesh.

24. **Mr. Govind Sarathy**
Journalist
1/286, Vinod Villa, Station Road
Matunga, Bombay - 400 019.

25. **Kasturi Bakshi**
A/42, Anandpuri
P.O. Nanchandran Puku
24, Parganas - 743 102
West Bengal.

26. **Dr. Rema Jagdish**
A-12, Visharamdham 7
Opp. LBS Marg, Mullund (West)
Bombay - 400 008.

27. **Mr. Avneesh H. Sharma**
150/D, Pratapnagar Railway Colony
Baroda - 390 004, Gujarat.

28. **Miss Rashika Chandola**
IT College, B-192
Avasvikas Colony
Rajajipuram
Lucknow - 226 017
Uttar Pradesh.

29. **Dr. R. Gopalkrishnan**
169, Paper Mall Road
Palli Palayam, KVR House
58, Ramanuja Nagar
Karunga Palayam
Erode - 638 003
Tamil Nadu.

31. **Basuda Prasad**
CSIO, Sector 30
Chandigarh.

32. **Mr. Rakesh Kumar**
47, Subash Nagar
Institute of Paper Tech
Ambala Road, SRNP.

33. **Mr. Narayan Chandra Dash**
Orissa Sponge Iron Project
Janardan Pursaan
Koonjhar Bazar
Keonjhar - 758 002.

34. **Miss. Champa S.N.**
Hindu Rao Hospital
H-494, Kali Bari Marg
Near Gole Market
New Delhi - 110 001.

35. **R. Shiva Kumar**
C-53, NAL Quarters
Bangalore - 560 017.

36. **Dr. Pratibha Gupta**
UCMS and GTB Hospital
Delhi - 110 095.

37. **Mr. Debasis Ray**
S/o N.K. Ray
Hyderabad Control Div. III
CPWD Nirman Bhawan
Sultan Bazar, Hyderabad - 500 195.

38. **Indira Nath Chatterjee**
PL-6/12/05, Sector - 17
New Panvel, Dt. Raigad - 410 206
Maharashtra.

39. **Mr. M.K. Patel**
A.M. (QC & Safety)
IDL Chemicals Limited
Rourkela - 769 016
Orissa.

40. **Mr. U.B. Kekde**
NEERI
Nagpur - 440 020
Maharashtra.

41. **Mr. Gaurav Garg**
KTPS, Ramtek
Dist. Nagpur
Maharashtra.

42. **Dr. Samidha Bansal**
MP Pollution Control Board
E-5, Arera Colony
Bhopal, Madhya Pradesh.

43. **Mr. K.G. Gupta**
D-6-D, Government Engineering College Complex
Farmagudi- 403 401

44. **Dr. S.S. Dhaktode**
Chemistry Depart.
Sidhart College of Arts & Science
Anand Bhawan
Dr. Dadabhai Naoroji Road, Fort
Bombay.

45. **Mr. V. Gyneshwar**
Room 8/5, Men Students' Hostel
Kakatiya Medica College
Rangampeet
Warangal - 506 007.

46. **Mr. J.P. Mathew**
House 31/998F, Chetichera Road
P.O. Vytilla
Cochin, Kerala.

47. **Mrs. J. Valarmathy**
W/o Mr. V. Santosh Kumar
Asst. Collector of Excise
Block I, Central Excise Quarters
Meenambalpuram
Madurai.

48. **P.A. Subramaniam**
A G M (M & S)
Salem Steel Plant
Tamil Nadu - 636 013

49. **Mr. P. N. Narayanan**
BE Cham
Plot 63, Kalianan Koil Street
Vriegambakkam, Madras

50. **Ms. Madhavi P. Patil, Ph.d**
(Biochem) Scholar
Inst. of Science, Bombay.

51. **Mr. A.K. Dhar**
Sr. Chemist
Scientific Research Lab
52/7, Kashi Nath Dutta Road
Calcutta - 700 036.

52. **Mr. N. Rammooile**
Consultant
8 Sathya Murthi Road
Coimbatore
Tamil Nadu.

53. **Mr. Rajesh Varma**
B-211, ONGCL Colony
Baroda-9
Gujarat.

54. **Mr. S. Chandra Kanth Rao**
Kothagudem
Andhra Pradesh

55. **Dr. A. B. Sahay**
Physician
Das Lane, East Lohanipur
Patna - 800 003
Bihar.

56. **Ms. Sarika David**
Punjabi University
Patiala, Punjab.

57. **Dr. A.K. Chakraborty**
IOC Ltd.
Digboi
Assam.

58. **Mr. Huma Nussat Hasain**
Msc 1st Year (Bio Sciences)
Jamia Milia
New Delhi

59. **Dr. Rita Kumar**
Centre for Bio Chem. Tech.
Mall Road
Delhi - 110 007

60. **Ms. Ashima Verma**
Mandi
Himachal Pradesh - 175 001

61. **Mr. S. Sathyabhama**
Bangalore - 560 0146

62. **Mr. P.K. Singla**
Asstt Prof.
Technical Teachers Trg. Inst.
Chandigarh.

63. **Dr. (Miss) Jyoti Lata Pandey**
Scientist
NML Flats, AGRICD
Jamshedpur

64. **Mr. Kapil K. Shama**
Tech. Asstt.
Jalandhar

65. **Mr. R.M. Sundaram & K. Narayan**
IIT, Madras

66. **Ms. Preeti Sharma**
Agra

67. **Mr. Santosh Kumar**
I year Chem.
Tamil Nadu

68. **Prof. Rolla S. Rao**
Hyderabad.

69. **Dr. D.B. Sawarker**
Nagpur - 440 022.

70. **Dr. Beena Rabadia**, MBBS
SSG Hospital
Baroda.

71. **Mr. M.T. Godbole**
Enu. Prot Manager
Motor Industry Cottd
Nashik.

72. **Mr. Arun Pande**
Engineer Pollution Control
(Industry in Sahibabad)
Ghaziabad.

73. **Miss Manorama Patri**
SRF
Zoology Deptt.
Revenshaw College
Cuttack.

74. **Mr. A.S. Gopalarjan**
Bangalore.

75. **Mr. R. Kasturibai**
Reader
Madurai Kamraj University
Madurai.

76. **Mr. P.K. Das**
Steel Workers Federation of India
Durgapur.

77. **Mr. R. Nallathambi**
Research Student
UDCT, Matunga
Bombay.

78. **Dr. Nandita & J.K. Moitra**
CPCB
New Delhi.

79. **Dr. Hari Om Gupta**
Archaelogical Survey of India
Dehradun.

80. **Dr. R.K.S. Dogra**
ITRC
Lucknow.

81. **Mr. Rohit Israni**
Thermax Ltd.
Bombay.

82. **Dr. H.N. Saiyed**
Regional Occ. Health Centre
Calcutta.

83. **Dr. S. Sharma & Shankar Rao**
Ayurveda Faculty,
Gramodaya Vishwavidyalaya
Chitrakut

84. **Puneet Saxena XI Arts**
Jaipur

85. **V. Saritha B.Sc. I year**
RR Nagar, Kakinada - 533 003
A.P.

86. **Pramod V Borde**
Aurangabad.

87. **D. Rajasekhar**
ACID, Hyderabad